Diesel Power
& Diesel Transportation

Diesels in the Railroad Industry

Our 28th Year

SEPTEMBER, 1950

YOU CAN DOUBLE

Reduce Diesel fuel and maintenance costs by using TEXACO URSA OILS

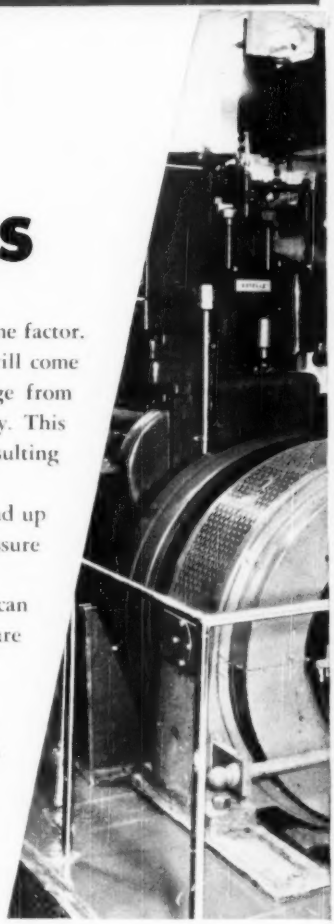
Clean engines do more to assure Diesel economy than any other one factor. Use *Texaco Ursa Oils* and your maintenance costs, for example, will come down, because *Texaco Ursa Oils* keep harmful carbon and sludge from forming . . . keep rings free, ports open, valves working properly. This means, of course, better compression and combustion . . . with a resulting reduction in the amount of fuel used.

Texaco Ursa Oils are especially made to resist oxidation and to stand up under heat and pressure. They protect bearings from corrosion . . . assure longer life for all moving parts.

Leading Diesel manufacturers approve *Texaco Ursa Oils*, and you can get them in suitable viscosities for every type and size of Diesel. They are easily America's No. 1 Diesel lubricating oils. In fact—

More stationary Diesel h.p. in the U. S. is lubricated with Texaco Ursa Oils than with any other brand.

Get a Texaco Lubrication Engineer to show you how *Texaco Ursa Oils* can make a double saving for you on your Diesel operation. Just call the nearest of the more than 2,000 Texaco Wholesale Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.



TEXACO

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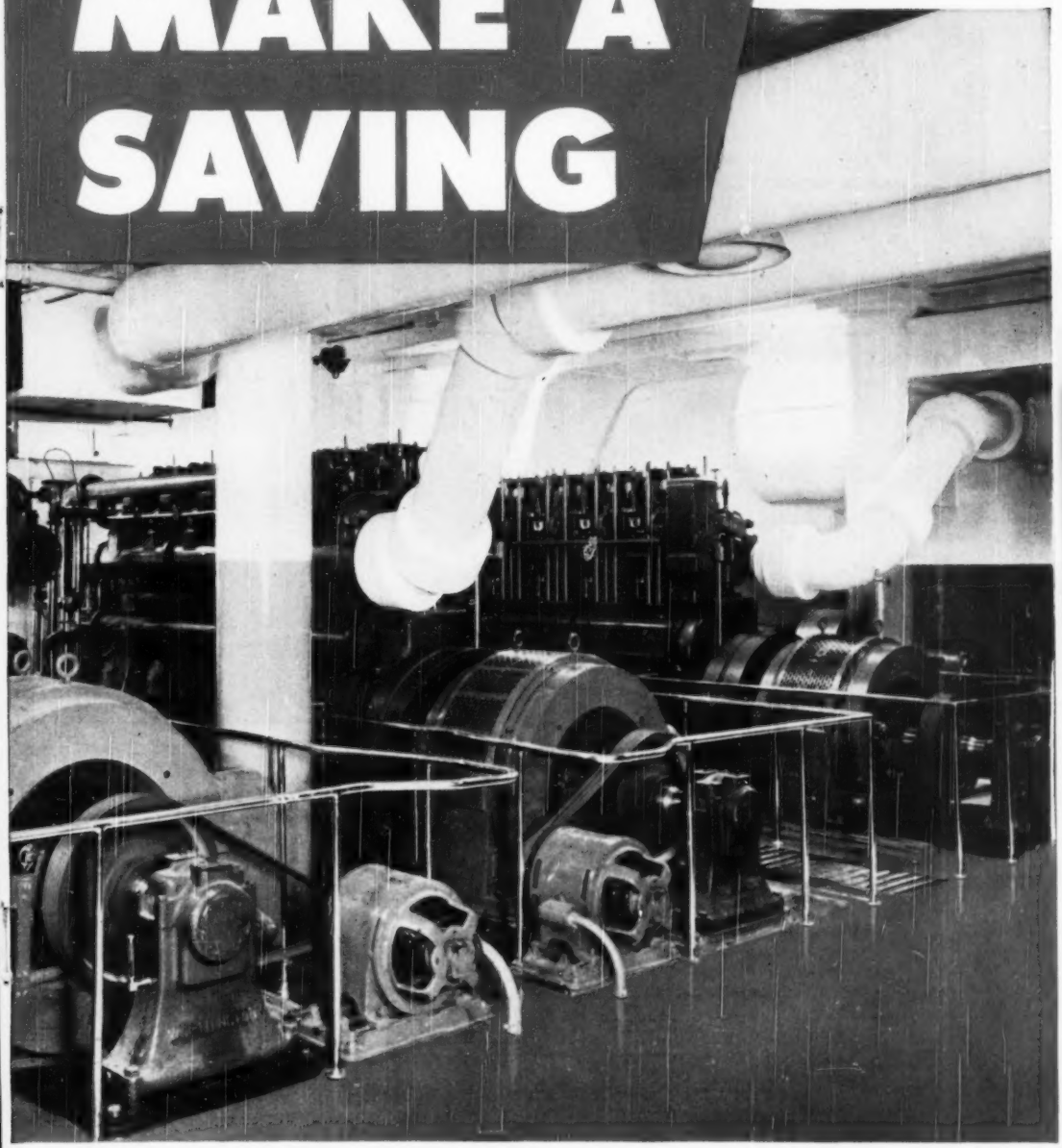
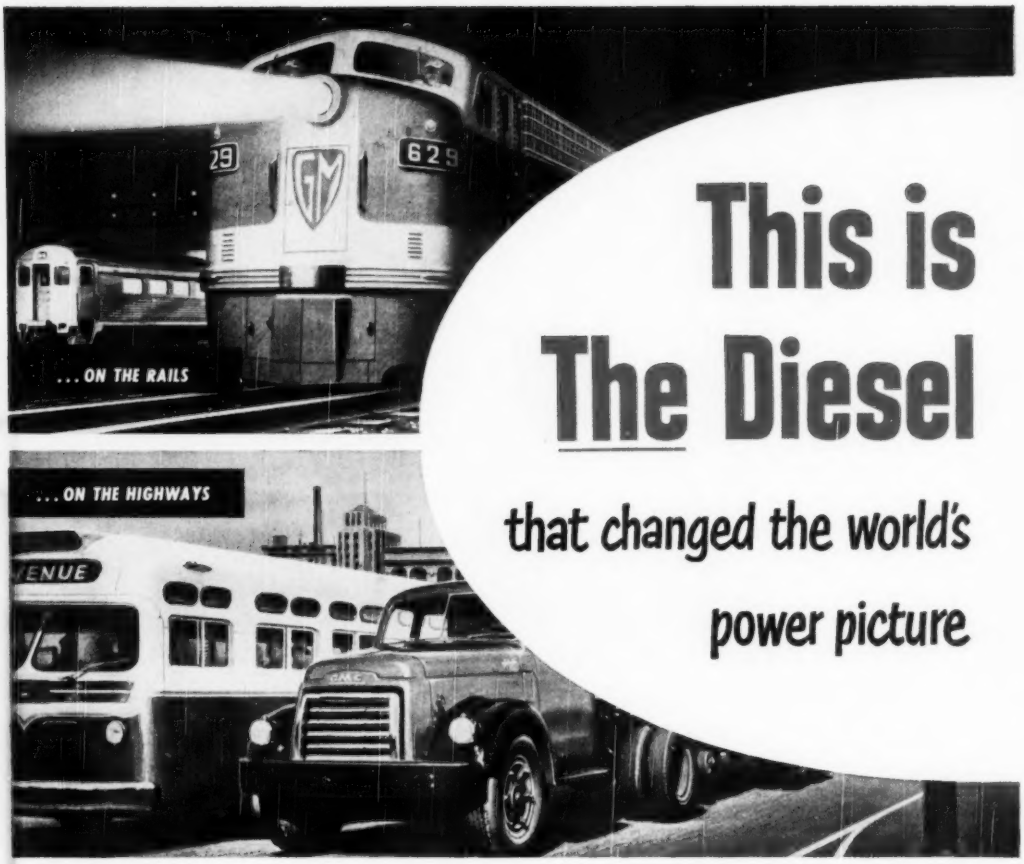
MAKE A SAVING



URSA OILS FOR ALL DIESEL ENGINES



This is The Diesel

that changed the world's power picture

ONE DIESEL—and one alone—blazed a trail which has won world-wide recognition for the oil-burning engine as the most economical source of smooth, dependable, agile power for locomotives, trucks, buses, marine and other mobile uses.

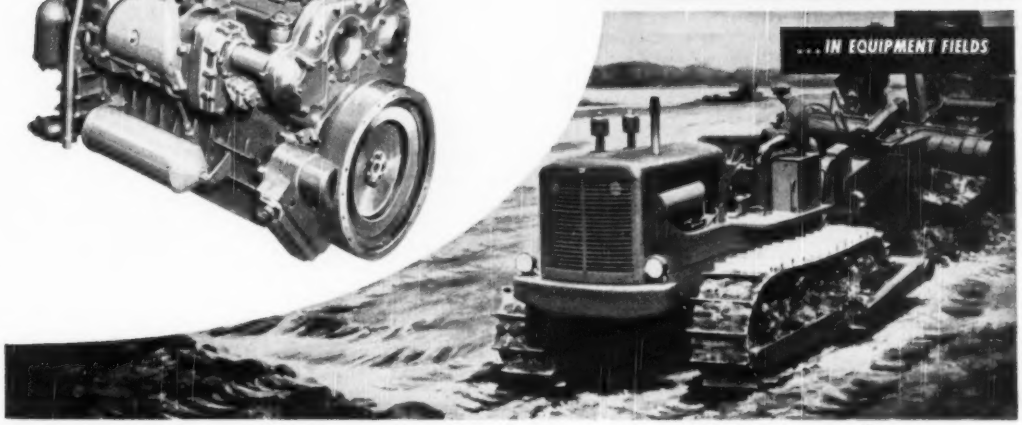
It is the General Motors Diesel engine, one size of which now drives most of America's crack passenger and freight trains. Another powers many of the Navy's submarines and other vessels.

And a third—the GM Series 71 engine—is the most widely used of all, totaling 46,000,000 horsepower. *It has surmounted the exacting conditions of War and met the economic requirements of Peace.* It has brought the same efficiency to a wide range of jobs, including many where Diesel power was never usable before.

That is because the "71," like all GM Diesels, is a two-cycle engine. Two-cycle means it produces power with every piston downstroke—in contrast to most other Diesels that generate power only on every second downstroke.

Equally important, GM Diesels have a direct jet-injection system that feeds fuel to cylinders in exactly metered charges—insuring better combustion and eliminating troublesome high-pressure fuel lines.

These basic differences make GM Diesels far more compact and much lighter than other Diesels of equal horsepower—without sacrificing ruggedness. These engines accelerate faster, are unmatched for smoothness, start quickly and are clean-burning.



"Your Key to Power Economy"

Today, GM Series 71 Diesel engines are taking the place of gasoline engines on many types of power jobs — of steam engines on land and sea — even of other Diesels because twelve years' experience has proved they are so dependable, so efficient, so economical.

General Motors 2-cycle Series 71 engines provide Diesel power at its best — *Diesel brawn without the bulk.*

Hear Henry J. Taylor on the air every MONDAY evening over the ABC Network, coast to coast.

Only GM Diesels provide all these advantages

- Smaller size, less weight per horsepower
- Two-cycle smoothness, power on every downstroke
- Quick starting, on its own fuel
- Unit injectors—no high-pressure fuel lines
- Rapid acceleration • Cleaner-burning
- Better high-altitude performance
- Easy accessibility

DETROIT DIESEL ENGINE DIVISION

SINGLE ENGINES . . . Up to 275 H.P. DETROIT 28, MICHIGAN MULTIPLE UNITS . . . Up to 900 H.P.

GENERAL MOTORS

GM GENERAL MOTORS DIESEL POWER

To Trim Your Diesel Down

Diesel engines no longer handicap the equipment they are installed in. No longer are heavy—bulky—or waste precious space.

Engine builders, in squeezing more horsepower into less space, have turned to aluminum. With aluminum, they lighten superchargers, frames and crankcases to half their ordinary weight. Aluminum pistons, supercharger impellers and connecting rods smooth vibrations—lessen inertia. And weigh less, too.

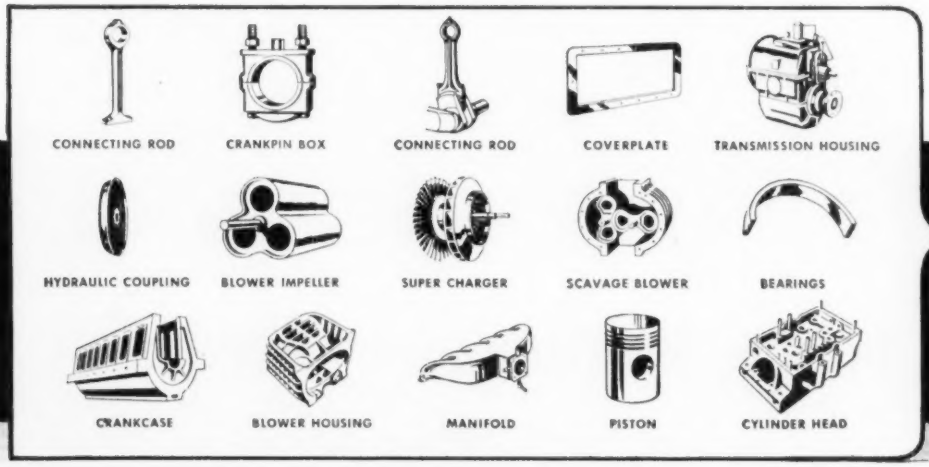
How was size reduced? By helping engines work harder. Aluminum lets pistons and rods move faster. Pistons and heads of aluminum can soak up the extra heat of higher mean effective pressures and piston speeds. Another way of saying aluminum makes engines lighter, smaller and/or more powerful.

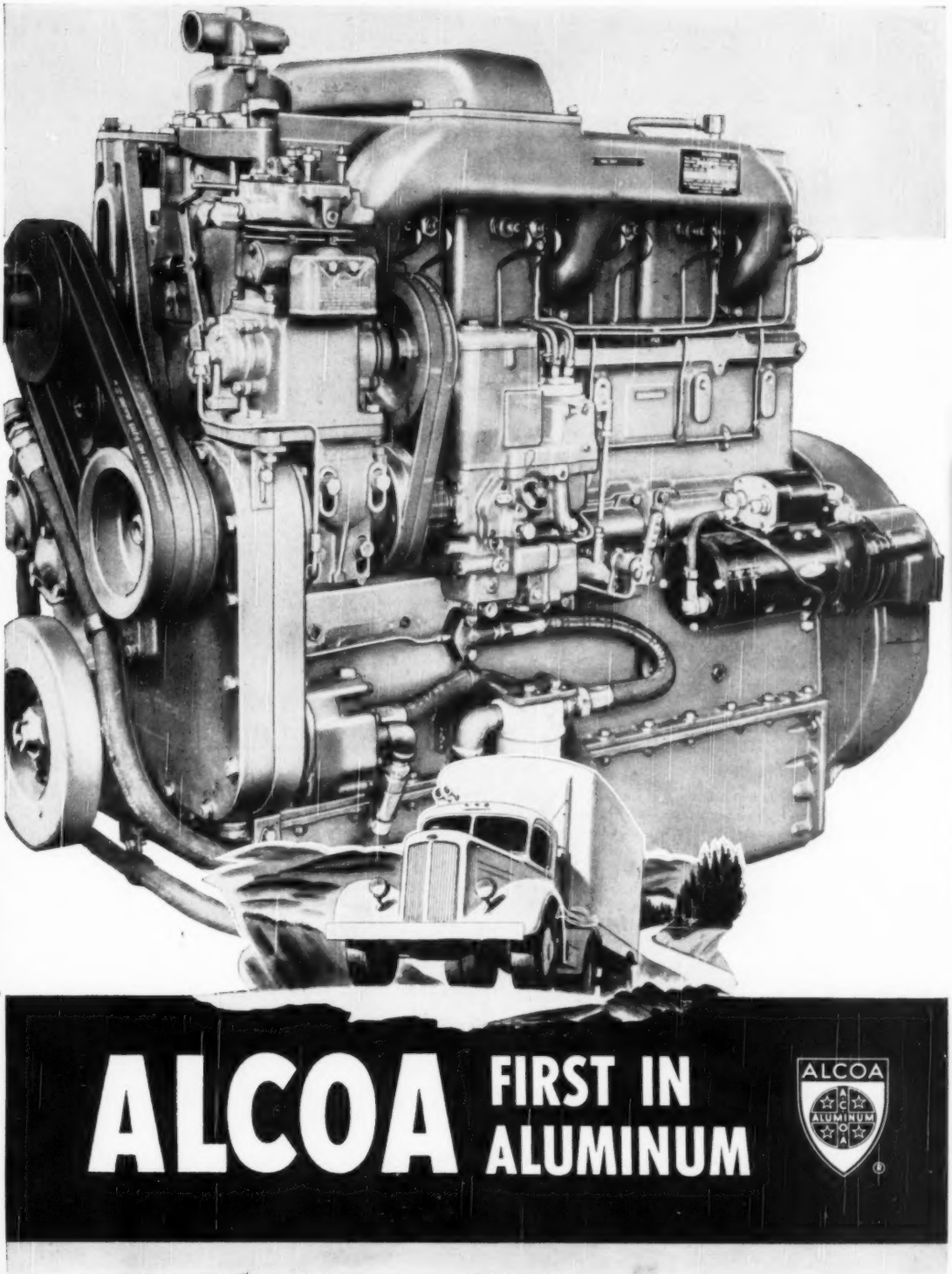
Aluminum makes better bearings. Their one-piece construction eliminates hard metal backing—eliminates bond failures. And for sheer bearing stamina you can't beat aluminum. More conductive of heat—more resistant to corrosion—stronger in repeated stress—stronger at elevated temperatures.

When you shop for diesels of any size—shop for aluminum. It's a sure sign of a better engine buy.

IF YOU BUILD DIESEL ENGINES . . .

Alcoa supplies engine builders with semi-finished parts from 5 modern foundries, 2 forge shops, 2 die casting plants. Alcoa researchers have worked with engine builders for the past 25 years in developing lighter, smaller, more powerful diesels. For complete information, write: ALUMINUM COMPANY OF AMERICA, 2100J Gulf Building, Pittsburgh 19, Pennsylvania.




ALCOA FIRST IN ALUMINUM
ALCOA
ALUMINUM

BALBOA

Uncovered Half a World...

Vasco Nunez de Balboa blazed a path across Panama in 1517. He opened the way to the Pacific and a vast new world. But that, at the time, was not understood. So, finally, Balboa was executed.

PORUS-KROME* *Opens the Way to* MORE DIESEL ECONOMY!

Diesel users are more appreciative of Porus-Krome than the Spanish king was of Balboa's discovery. But then, the king lacked facts by which to judge the value of what Balboa had done.

About Porus-Krome, of course, the facts are known. Now that Vanderloy M has been added, there is no excuse for scrapping *any* Diesel liner. That means, *all* your present liners can last indefinitely.

Gone are the costs of oversizing, of stocking, handling and storing oversize parts. No need for loss in engine availability, for lower combustion and lubrication efficiency resulting from *unprocessed* liners.

In the 10 years since Porus-Krome first proved its value, major Diesel users have shown increasing profits from this process. That's why they specify it in original equipment and use it 100 percent.

If *you* don't, it must be because you haven't the facts. Those facts are waiting for you. Get in touch with us today.

* * *

**PORUS-KROME is a dense, hard, wear and corrosion-resistant chrominum, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication*

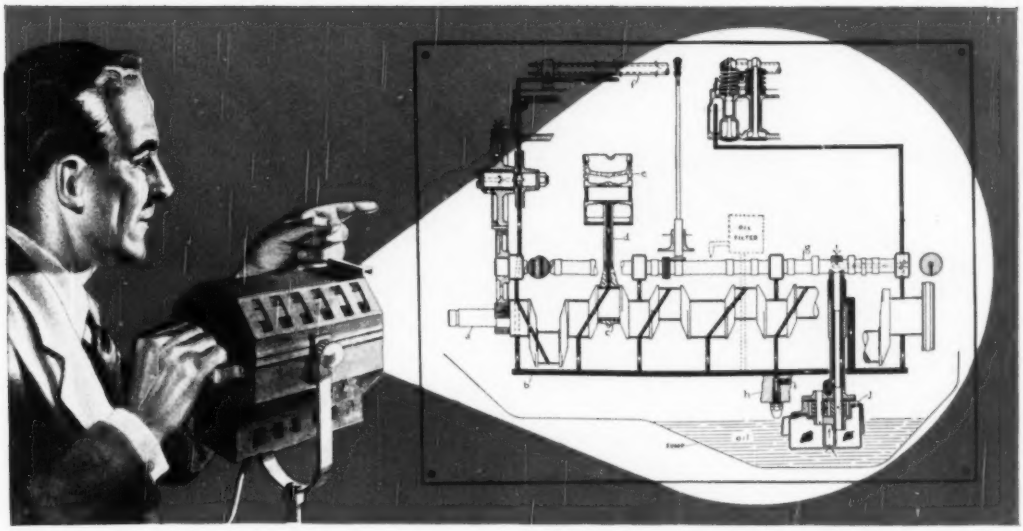
VAN DER HORST CORPORATION OF AMERICA • OLEAN, N. Y.

U. S. PATENTS 2,048,378, 2,314,604 and 2,412,598

PORUS - KROME

Good for the Life of your Engines

VAN DER HORST



Man with a new light on your DIESEL LUBRICATION

EVEN THE NORMAL EFFECTS from compression, combustion and load make it tough enough for any Diesel engine oil. Yet in addition you want to be sure your Diesel oil will be master of special needs —sometimes imposed by particular mechanical conditions . . . or by fuel characteristics, load or even by factors of climate and altitude.

You'll get a new light on this whole range of lubrication complexities, as it affects your own Diesels, by calling in a Cities Service Diesel Lubrication engineer. He is qualified to tailor a Diesel lubrication program that will contribute to maximum hourly output and sharply lower costs. Like scores of other Diesel operators throughout industry you can profit by drawing on the knowledge and experience of a Cities Service Diesel specialist. Contact the office nearest you, or return the coupon below. It brings details—plus a valuable Diesel booklet, free.

The Cities Service Complete Line of Top Quality Petroleum Products includes

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Sixty Wall Tower, Room 780
New York 5, N. Y.

Please send me without obligation your new booklet, "Diesel Engine Lubrication."

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Company_____

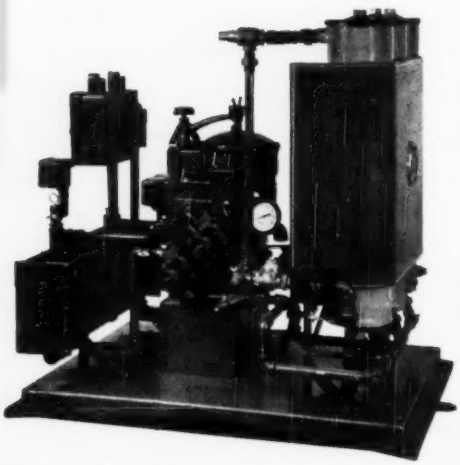
Address_____

City_____ State_____

3 YEARS OF EXPERIENCE PROVE THE "PURI-FILTER" IDEA IS SOUND

The De Laval "Puri-Filter" — centrifuge plus filter — has now been on the scene approximately three years. The numerous installations made during that time now give ample proof that the basic idea behind the "Puri-Filter" is correct. Centrifugal force and micronic filtration can do a more thorough job of cleaning diesel oil than any other device in existence, and better, in fact, than either centrifugal force or filters by themselves. It is economical, too — the centrifuge relieves the load on the filters and lets them remain in service longer.

The De Laval "Puri-Filter" removes the materials that cause ring sticking, sludging and coking. Dirt, water and colloidal carbon are all promptly separated out of the oil, which is left clean and clear in color, and ready for indefinite re-use.



THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
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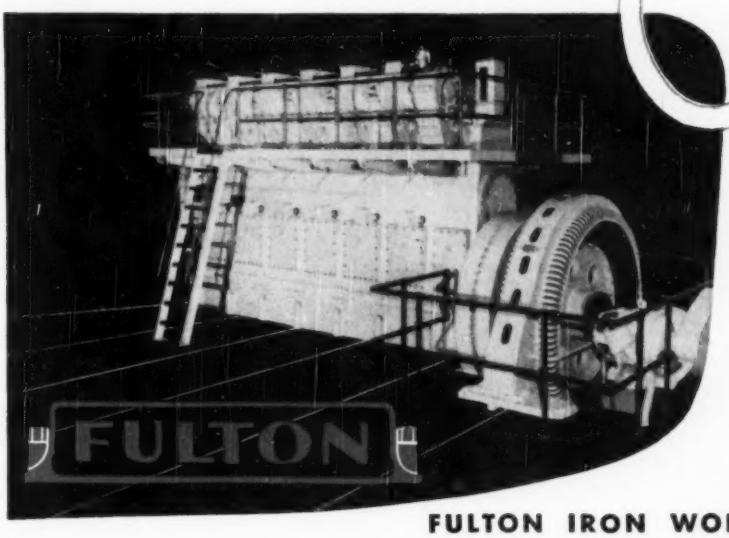
DE LAVAL
Oil Purifiers
FOR DIESEL LUBRICATING OIL

FULTON DUAL-FUEL CUTS CUSHING FUEL COSTS TO 1.75 MILLS PER K.W.H.!

In June, 1949, the Cushing, Oklahoma, municipal plant installed this Supercharged FULTON Dual-Fuel Type BGSSD — a 4-cycle, 6-cylinder engine with 17½ in. bore, 24½ in. stroke, rated at 1,420 HP at only 277 rpm.

The city's engineers chose a FULTON because they wanted a slow speed, heavy duty engine they could depend on for economical, unfailing service over many years. The record of its first year's performance proves they made a wise choice:

- Fuel costs total just 1.75 mills per K. W. H.
- Btu. consumption always lower than guarantees — only 6535 Btu. per Bhp./Hr. at full load
- The FULTON Dual-Fuel is so economical that it is run 24 hours a day — even at 60% loads which could be carried by the plant's smaller, but less efficient engines



Only FULTON Dual-Fuels give you such remarkable operating economy plus PUSH-BUTTON DUAL-FUEL SWITCH — 2-second change-over by remote control without missing a beat or leaving your seat! Compare and you'll choose

50 YEARS YOUNG

FULTON IRON WORKS COMPANY

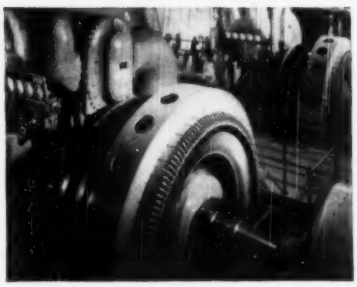
SAINT LOUIS 14, MISSOURI • New York Office: 82 Wall Street, New York 5

AT YOUR SERVICE: *50 years*

High-quality generators at minimum cost . . . the natural result of 50 years of G-E generator-building experience

Quality that gives you the most for your generator dollar is the natural result of more than half a century of generator building . . . the result of skills developed by men like Charles Wahl.

A machinist for more than 40 years, Mr. Wahl learned his high standard of workmanship from men like his father, also a master machinist. Today he's passing his tradition of craftsmanship along to younger men . . . teaching them to build G-E quality into electric equipment. We're proud of Charles Wahl, and Mr. Wahl is proud to help us give you the service that's your right as a G-E customer.



Dependability and high operating efficiency are characteristic of every G-E synchronous generator . . . the result of more than 50 years' experience in development, manufacture, and application of synchronous generators. Performance records of thousands of these sturdy, efficient generators now on the job have made G.E. a "buy" word for purchasers of power-generation equipment. Apparatus Department, General Electric Co., Schenectady 5, N. Y.

Your Best Generator Buy...

of know-how
GENERAL ELECTRIC
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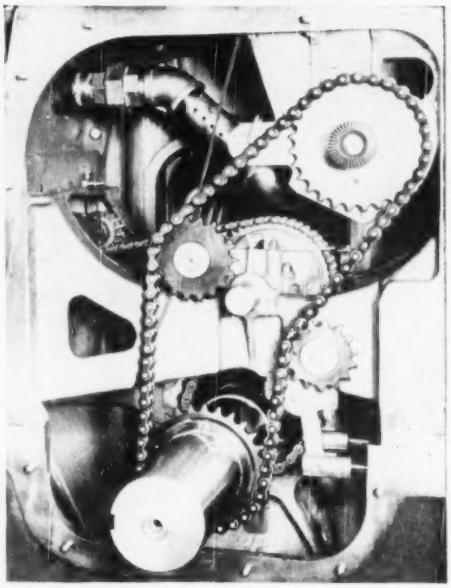
Design with Chain . . Specify LINK-BELT

The obvious advantages of chain for driving accessories on gasoline and Diesel Engines are further heightened by selecting Link-Belt Chain Drives.

By reason of vast experience and unsurpassed facilities, Link-Belt chain specialists can be of exceptional assistance to designers and builders of all types of internal combustion engines.

Exclusive features of Link-Belt chain drives give smooth, efficient service throughout the life of the drive.

Consult Link-Belt on any phase of engine design as influenced by use of chain drives and especially, ask us about a test drive for your new model engines.



Three Link-Belt Precision Steel Roller Chain governor and water pump drives on Model 80 and 80X "Superior" Diesel Engines manufactured by Superior Engine Division of the National Supply Company. Also a triple width roller chain is used on the camshaft drive.

WHY CHAIN DRIVE?

Compact, Positive, Flexible, Efficient.
Easy to apply, install, lubricate.
Quiet, smooth action; minimum backlash.

Link-Belt Duplex Silverstreak Silent Chain for timing and for fuel pump drive of Sheppard Model 12 Diesel Engine.

WHY LINK-BELT CHAIN?

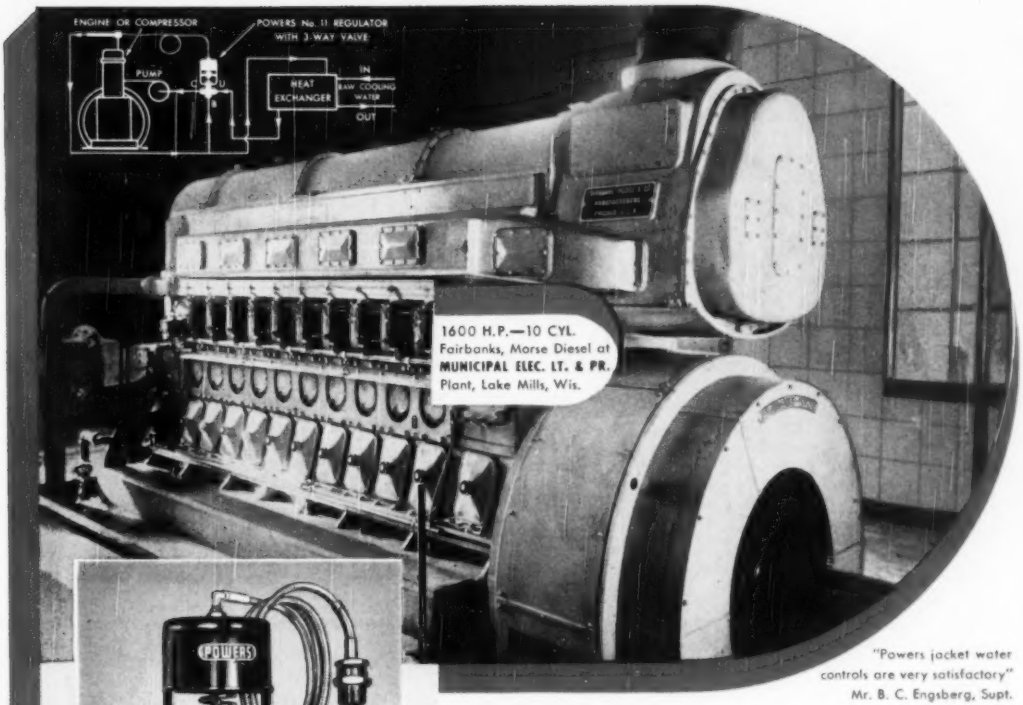
Long experience, largest facilities.
Precision manufacture, advanced design.
Exclusive split bushing pin joint, self-adjusting (on Silent Chain).
Extra long life, maintained efficiency.
Test Drive shipped promptly.

LINK-BELT COMPANY

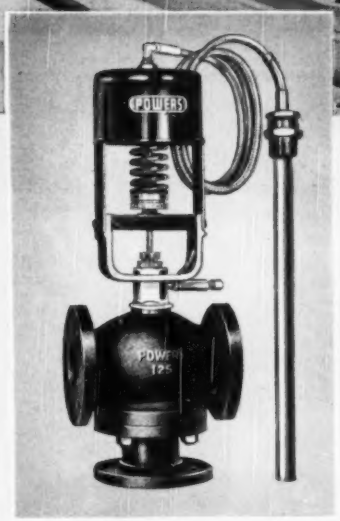
Chicago 9, Indianapolis 6, Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8, Johannesburg. Offices in Principal Cities.

11,342

LINK-BELT
Chain Drives
SILENT AND ROLLER TYPES



"Powers jacket water controls are very satisfactory"
Mr. B. C. Engsberg, Supt.



POWERS No. 11 REGULATOR, Self-Operating, with 3-Way Water Mixing Valve

Provides dependable, economical control of jacket water temperature. Is used on either soft or raw water supply. Also available with direct or reverse acting valve. Drawing above shows only one of many possible combinations. Pneumatic controls also available.

POWERS
TEMPERATURE CONTROL

POWERS—Jacket Water Temperature Control Improves Combustion and Efficiency Reduces Fuel and Lube Oil Consumption

Costs less than a set of new piston rings. Often pays back its cost the first year. Helps prevent the danger of piston seizure.

Dependable control of jacket water temperature is assured by a POWERS regulator which automatically compensates for load changes. Accurate temperature control results in better lubrication, longer cylinder liner wear and fewer piston ring replacements.

Whether you want a simple self-operating regulator, like the one shown here, or pneumatic controls we can supply both. Why not have a Powers engineer call and study your requirements for better temperature control? There's no obligation. With almost 60 years of experience we may be able to help you select the type that will give best results. THE POWERS REGULATOR CO., Offices in Over 50 Cities. See your phone book.

MAIL TODAY

(D11)

The Powers Regulator Co., 2710 Greenview Ave., Chicago 14, Ill.

Have engineer call to study our requirements for better jacket water temperature control.

Name of Engine or Compressor..... HP.....

Your Name.....

Address.....

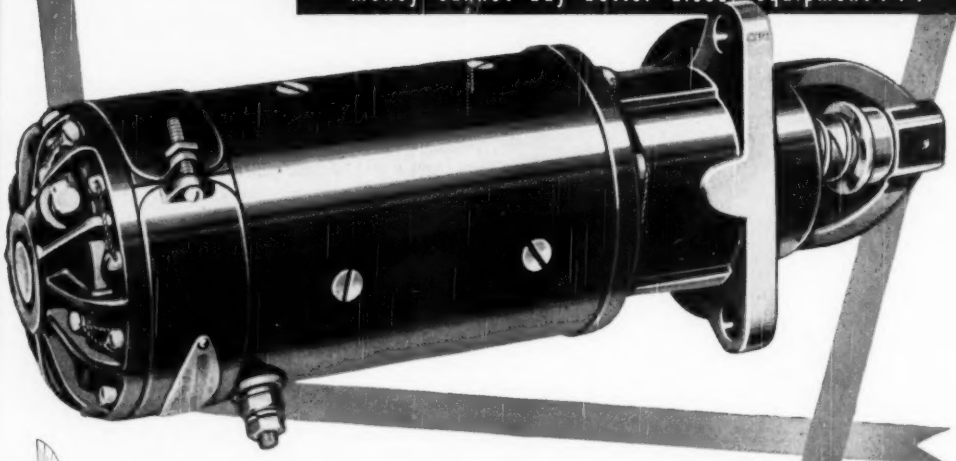
City..... State.....

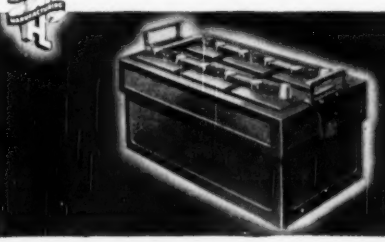
Switch to AUTO-LITE diesel equipment

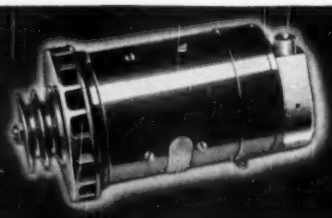
● The result of Auto-Lite's 38 years of automotive electrical experience, Auto-Lite Diesel systems are complete from generator to voltage control to battery to starter. The dependability of Auto-Lite electrical units in service has made Auto-Lite the world's largest independent manufacturer of automotive electrical equipment. Engineers and executives are invited to consult with us on Diesel cranking and generating equipment.

THE ELECTRIC AUTO-LITE COMPANY
Sarnia, Ontario Toledo 1, Ohio

Money cannot buy better diesel equipment . . .







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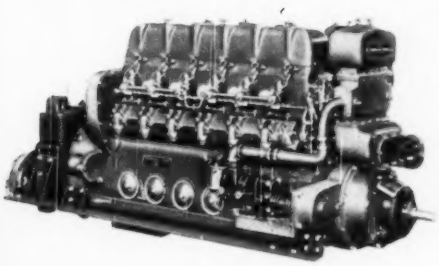
ALL THE ADVANTAGES OF THIS NEWEST 20 TO 138 HP. DIESEL ENGINE

Marine Model 49



Stationary Model 49

FAIRBANKS-MORSE MODEL 49

- efficient 2-cycle design
- lower weight per horsepower
- easiest to service
- more reserve power

Now is the time to send for complete information—the brand-new catalog—on the latest addition to the long line of well-known Fairbanks-Morse 2-cycle engines—the Model 49. See how its design embodies a new approach to diesel engine manufacture, with all major castings of lightweight corrosion-resistant alloys—combining lower weight per horsepower with new standards of operating efficiency.

You'll see how the Model 49 is simpler—easier to understand—with fewer parts—that it is the easiest to service diesel in its class. You'll note too, that there is a maximum interchangeability of parts among all models. Ideal for the broadest range of marine propulsion and generating service, the Model 49 is a thoroughly proved engine backed by over 10,000,000 Fairbanks-Morse Diesel horsepower.

New

UNITIZED CYLINDER HEAD AND LINER ASSEMBLY

Days of servicing or overhaul time are now shortened into hours with the new Model 49 design. Cylinder head, liner, piston, and rod assembly is quickly removed as a unit without disturbing engine mounting and without even dropping the oil pan. Complete cylinder assemblies are interchangeable, permitting transfer from one engine to another. Lost operating time is cut to a minimum.

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A brand-new catalog is waiting for you—fill in this coupon and send it today. Get the whole story on this newest, finest, 20-138 hp. diesel engine.

FAIRBANKS-MORSE,

a name worth remembering

DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • PUMPS • SCALES
HOME WATER SERVICE AND HEATING EQUIPMENT • RAIL CARS • FARM MACHINERY

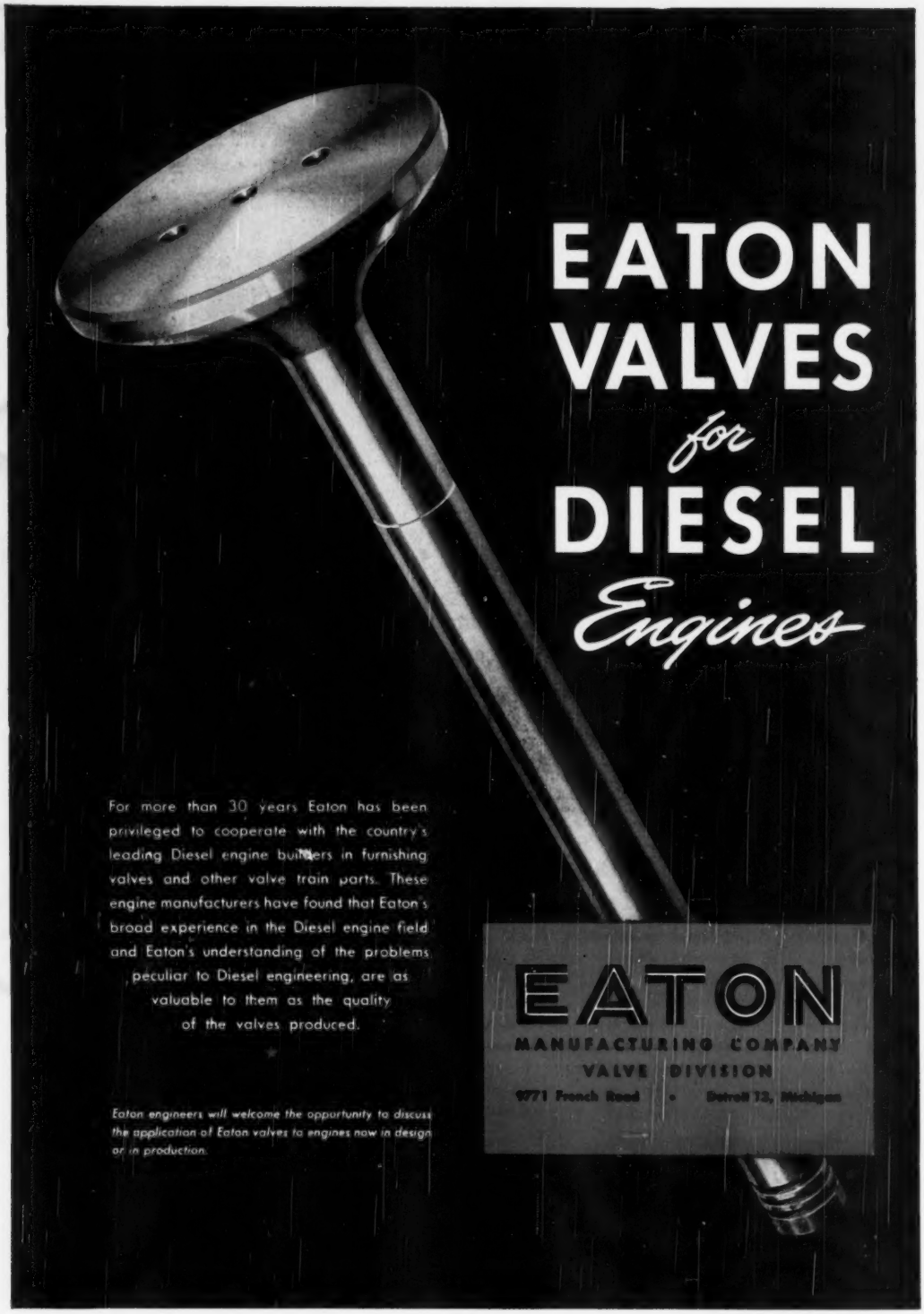
Fairbanks, Morse & Co.
600 South Michigan Avenue
Chicago 5, Illinois
Send me the new Model 49 Engine Catalog.

Name .....

Firm Name .....

Address .....

City ..... State .....


EATON
VALVES
for
DIESEL
Engines
For more than 30 years Eaton has been privileged to cooperate with the country's leading Diesel engine builders in furnishing valves and other valve train parts. These engine manufacturers have found that Eaton's broad experience in the Diesel engine field and Eaton's understanding of the problems peculiar to Diesel engineering, are as valuable to them as the quality of the valves produced.
Eaton engineers will welcome the opportunity to discuss the application of Eaton valves to engines now in design or in production.
EATON
MANUFACTURING COMPANY
VALVE DIVISION
9771 French Road • Detroit 32, Michigan

From A SIMPLE SWITCH

To AN AUTOMATIC BRAIN

SYNCHRO-START CONTROLS
FIT EVERY ENGINE REQUIREMENT

The control panel pictured above is that used for FIRE PROTECTION at many large manufacturing plants — air fields — hospitals — theatres — department stores — office buildings and which is accepted by Insurance Companies as wholly dependable protection.

Engines controlled by SYNCHRO-START have opened many new fields providing huge savings for the users of engine power as the main source, or as stand-by in case of emergency.

For the past eighteen years, SYNCHRO-START CONTROLS have been constantly rendering dependable service and protecting lives and property all over the world — on the seas, in the air, on land and in the mines.

The duty and functions of SYNCHRO-START CONTROLS are:

1. To automatically START an engine at a predetermined TIME or a CONDITION when power is needed, no matter what the application may be.
2. To automatically STOP that engine when its power is no longer needed and to have it ready for the next POWER DEMAND.
3. To automatically PROTECT that engine, its accessories and the *equipment* it is driving, against any abnormal condition that may cause *damage* while it is running. Also to indicate the cause of any trouble should it occur.
4. To afford valuable SAVINGS by having a DEPENDABLE source of power always available.

If you are not familiar with the SAFETY and the ECONOMY provided by SYNCHRO-START CONTROLLED ENGINES, ask your engine manufacturer—engine dealer—engineering firm, architect, or write to us for free information and our nearest representative.

SYNCHRO-START PRODUCTS, INC.
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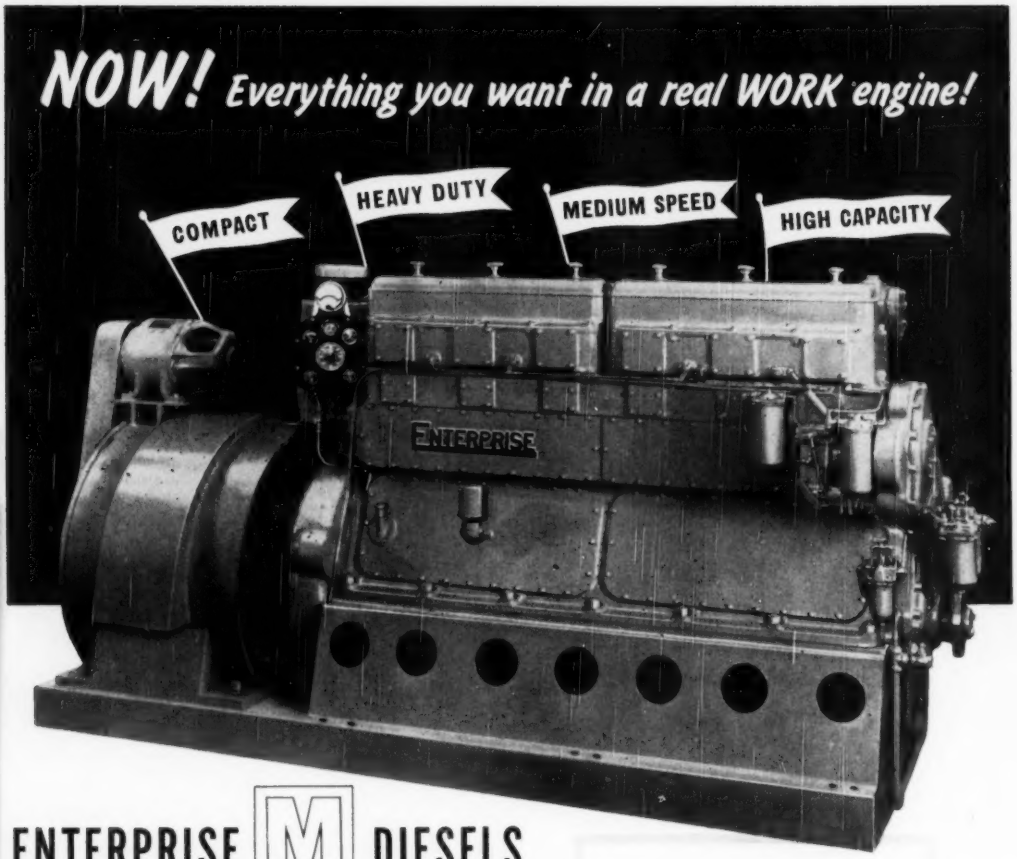
OVERSPEED GOVERNORS • SOLENOIDS • TIME ELEMENTS • RELAYS • SWITCHES • SAFETY CONTROLS • RECORDING CONTROLS • PRE-SET AUTOMATIC OR MANUAL CONTROL SYSTEMS FOR INTERNAL COMBUSTION ENGINES

NOW! Everything you want in a real WORK engine!



ENTERPRISE M SERIES DIESELS

Designed and developed to meet the demand for tough and continuous operation at medium speeds, Enterprise M Series Diesels in 3, 4 and 6 cylinder models are now available for the most economical solution to your power requirements using a wide range of low grade fuels. Compact, portable or completely contained if desired, these units deliver 68 to 240 BHP at conservative speeds of 450 to 750 RPM. They are WORK engines, capable of thousands of hours in demanding service, at low operating cost, with minimum maintenance and servicing requirements. When you compare, feature for feature, you're sure to make your next diesel a medium speed, high capacity Enterprise M engine—for years of the smoothest power you've ever enjoyed.

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- 8" bore x 10" stroke
- Compact, medium speed, heavy duty
- Easy starting, air or electric
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- Low fuel consumption
- Smooth, quiet, clean operation

Enterprise STATIONARY Diesels

Write for new Enterprise M Series Bulletin No. M-16, or call your nearest Enterprise office for complete information.

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A Subsidiary of General Metals Corporation
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TAMES A
POWER THROB
FLEXINEERING ELIMINATES VIBRATION ON TUG DIESEL EXHAUST
. . . PROVIDES SMOOTHER POWER . . . COOLER OPERATION
When the giant 16 cylinder, 1750 horsepower diesel engine of the new tugboat, Grace Moran, roars into action, there's a smooth purr of silky power. And one of the keys to this vibration-free operation is "flexineering"—the scientific engineering of flexible metallic tubing to industry's specific needs.
From the exhaust to the stack is a five foot length of Penflex air jacketed 14 inch, interlocked, flexible metallic tubing which achieves a circulation of air and an efficient cooling action.
Tough, rugged tubing that keeps exhausts as tight as a pipe . . . yet provides all of the flexibility necessary to "soak up" the constant vibration.
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Philadelphia 42, Penna.
Branch Sales Offices
BOSTON • NEW YORK • CLEVELAND
CHICAGO • HOUSTON • LOS ANGELES
Penflex... HEART OF INDUSTRY'S LIFE LINES

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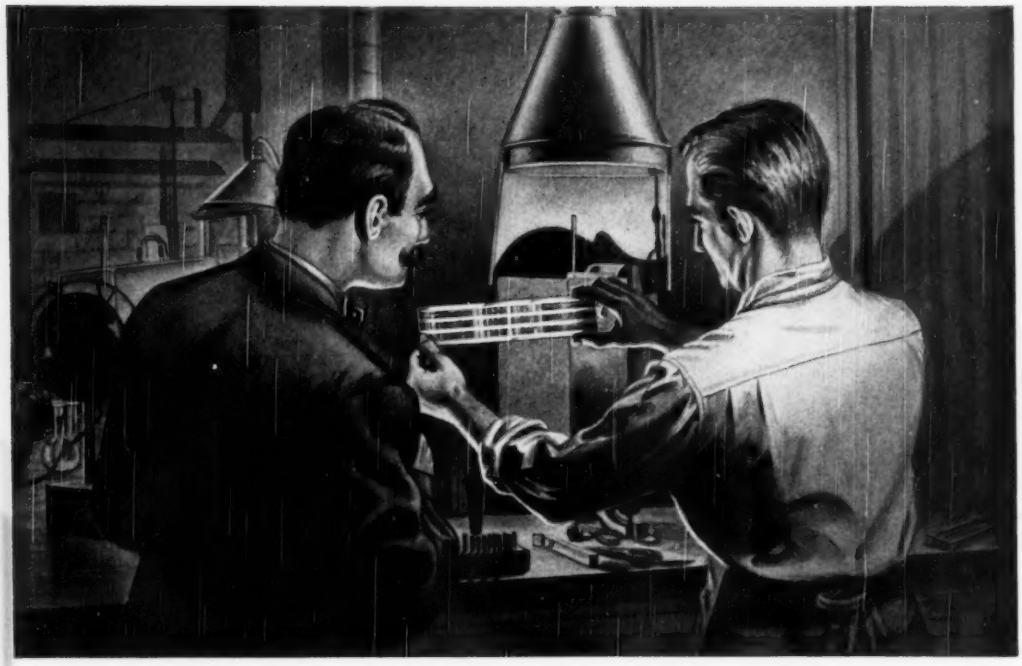

Look at this Exide spectrogram*, Mr. Diesel

See how accurately . . . and to what minute degree . . . every element in the lead is measured.

What and *how much* are important to know. For a very small percentage of certain elements can affect battery performance and life.

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Exide Diesel Cranking Batteries pass those tests with credits to spare. That's why you can count on Exides for a quick breakaway and a high cranking speed.

It's also the reason why so many makers and users of Diesel engines choose Exide Batteries . . . why these batteries are best for you.

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Philadelphia 32
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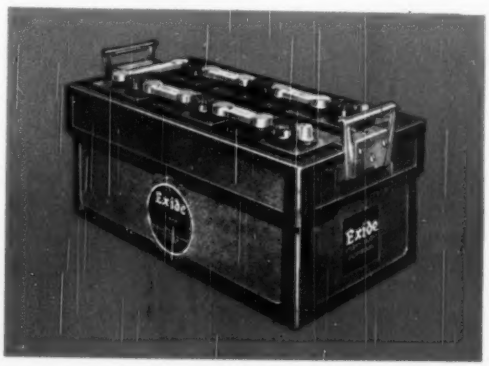
DEVELOPMENT WORK NEVER CEASES in improving the performance of Exide Batteries. Our staff of engineers, chemists, metallurgists, physicists and technicians is the largest in the battery industry.



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Your NAPA Jobber is a Good Man to Know!

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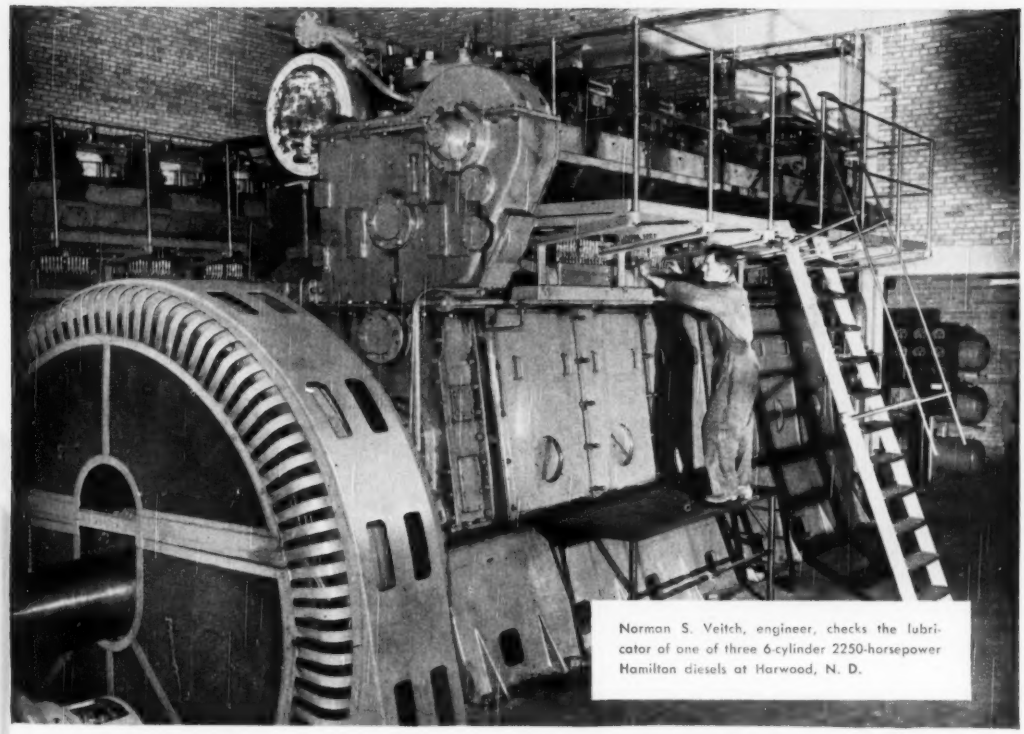
FOR ENGINE BEARINGS
CLUTCH PLATES AND PARTS
CHASSIS PARTS

Monmouth is the name



Norman S. Veitch, engineer, checks the lubricator of one of three 6-cylinder 2250-horsepower Hamilton diesels at Harwood, N. D.

HAMILTON DIESELS

" . . . about as perfect a machine as we could get"

says the Chief Operator of this plant

This is the Harwood, North Dakota, plant of the Minnkota Power Cooperative. Since early 1947, three Hamilton diesels, each rated 2250 hp at 240 rpm, have been supplying 1,200,000 to 1,500,000 kwh per month to about 30,000 customers.

Mr. Helmer N. Eraker, Chief Operator since the plant began functioning, says "Considering everything, we have had a minimum of trouble. Under the job it is called upon to do, it is doing well—about as perfect a machine as we could get."

* * *

Hamilton diesels, with 21½ inch bore and 27½ inch stroke, are available with 5 to 12 cylinders. Ratings are 482½ bhp (net) per cylinder as a straight diesel and 455 bhp per cylinder as a dual fuel engine, both at 257 rpm. For full information, call the Lima-Hamilton Sales Offices in New York or Chicago, representatives in other cities, or write directly to Lima-Hamilton Corporation, Hamilton, Ohio.

LIMA HAMILTON CORPORATION

HOOVEN, OWENS, RENTSCHLER CO. **HAMILTON, OHIO**

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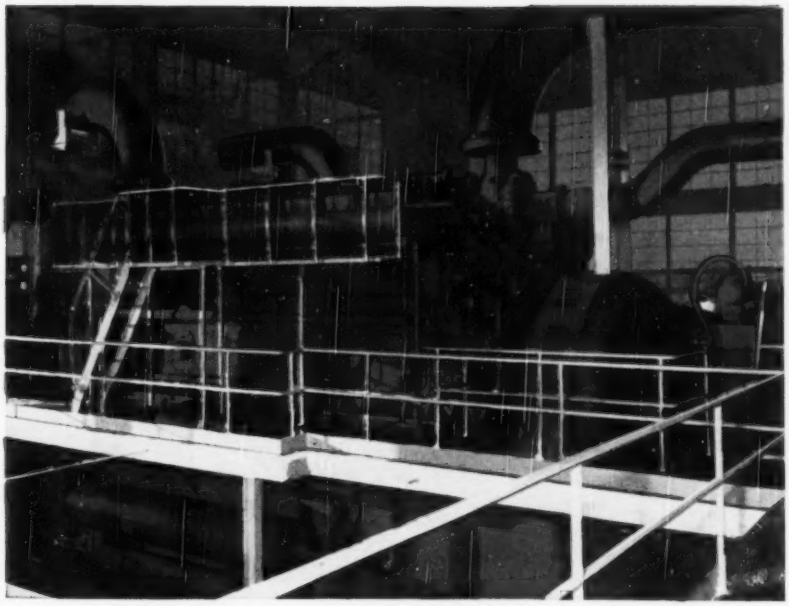

New
Cooper-Bessemer
V-Design Engine

Arizona Edison's new power plant at Yuma features this 16-cylinder, 3400 h.p. Cooper-Bessemer V-Design Gas Diesel, the first of its type to be put into service. This engine produces double the power of an in-line 8, with practically no increase in size. The plant is also equipped with an 8-cylinder, 1650 h.p. Cooper-Bessemer Gas Diesel. Both engines have a 15½" bore, 22" stroke and are rated at 327 r.p.m. The plant operates around the clock, seldom dropping below its rated capacity of 3375 k.w.

KOPPERS PISTON RINGS Used in the New Cooper-Bessemer V-Design Engine

KOPPERS American Hammered Piston Rings, made of the new special alloy iron with Porous Chrome plated cylinder contacting surfaces, play a big part in the successful operation of Cooper-Bessemer's new 16-cylinder Gas Diesel Engine, now running at capacity 24 hours a day in Arizona Edison's new plant at Yuma. Diesel manufacturers *depend on Koppers* for piston rings that deliver *more* power over a *longer* period of time! Plant engineers everywhere report *better* cylinder protection . . . *less* cylinder wall and ring groove wear . . . *lower* maintenance costs . . . in Diesels equipped with Koppers Piston Rings! Check up on your Diesel operating costs today . . . and next time you overhaul, specify Koppers!

Koppers Other New Piston Ring Materials Give *New*, Longer Life to Engines! Koppers K-Spun is an entirely new type of cast iron for rings, made by an exclusive centrifugal casting process, which forms graphite into large nodules instead of fine flakes. Koppers K-Spun Piston Rings are 100% stronger, 50% more elastic, four times more shock resistant than ordinary ring material . . . *guaranteed* not to break in installation or in service! For gasoline and Diesel engines (up to 12½").

Koppers Porous Chrome Rings reduce cylinder wall wear *50% or more* by actual test! The famous Van der Horst Plating Process provides a porous chrome surface that distributes oil for better lubrication during break-in, and wears down to perfectly seated solid chrome that gives up to *twice as much service* between overhauls! For gasoline and Diesel engines (on specification).

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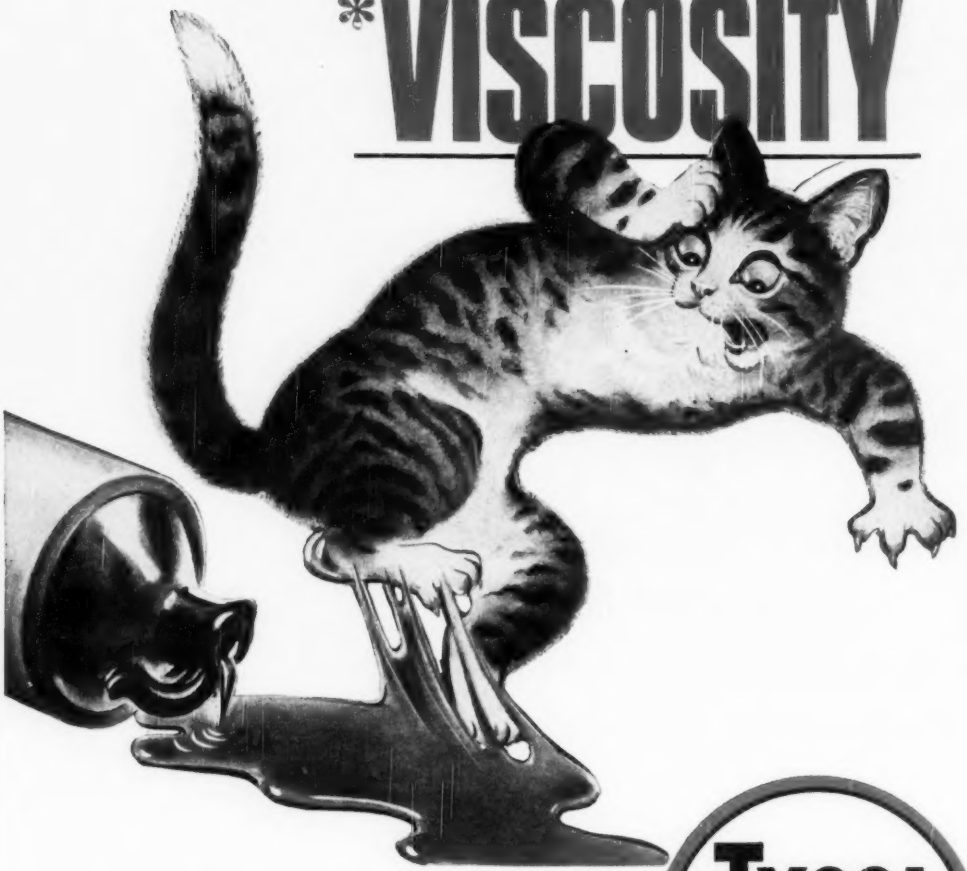
KOPPERS

KOPPERS *American Hammered* **PISTON RINGS**

*VISCOSITY



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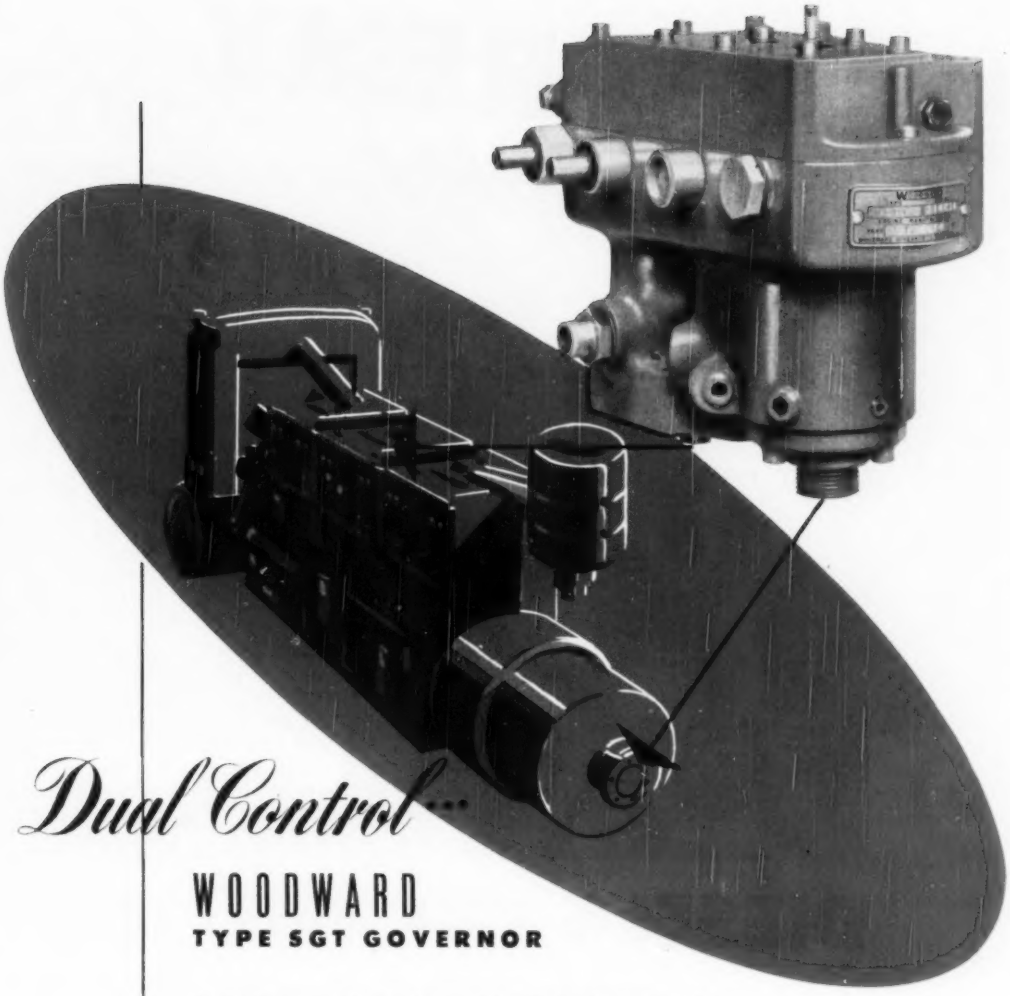


Dual Control...

WOODWARD
TYPE SGT GOVERNOR

A single governing unit provides limitation of engine and converter shaft speeds, governed control of engine power level to maintain desired output shaft speed with varying loads, and engine power level control to vary output shaft speed down to stall.

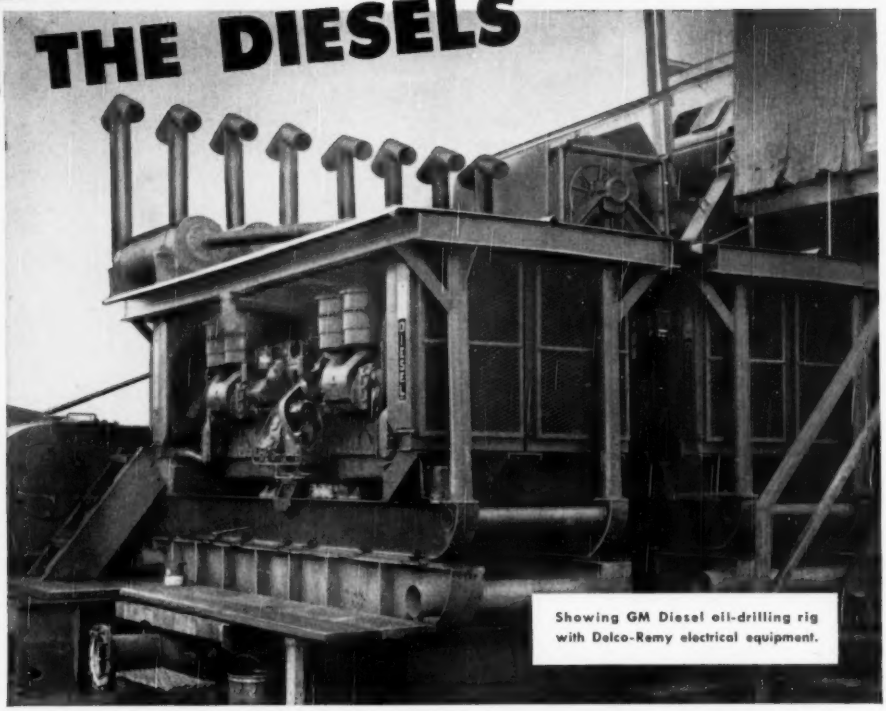
80 WOODWARD SERVICE

World's oldest and largest exclusive manufacturer of hydraulic governors for prime movers.

WOODWARD GOVERNOR COMPANY

ROCKFORD, ILLINOIS

DELCO-REMY ON THE DIESELS



Showing GM Diesel oil-drilling rig with Delco-Remy electrical equipment.

DIESELS ON THE JOB

Oil drilling is a rugged business—good business for rugged Diesel equipment.

And where there are Diesels you will find Delco-Remy heavy-duty electric units, designed to match the ruggedness and efficiency of the Diesel engines.

Diesel plus Delco-Remy is an on-the-job combination that has delivered reliable performance since Diesels became a factor in the oil industry.

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DELCO-REMY—A UNITED MOTORS LINE
Service Parts and Delco Batteries
Available Everywhere Through
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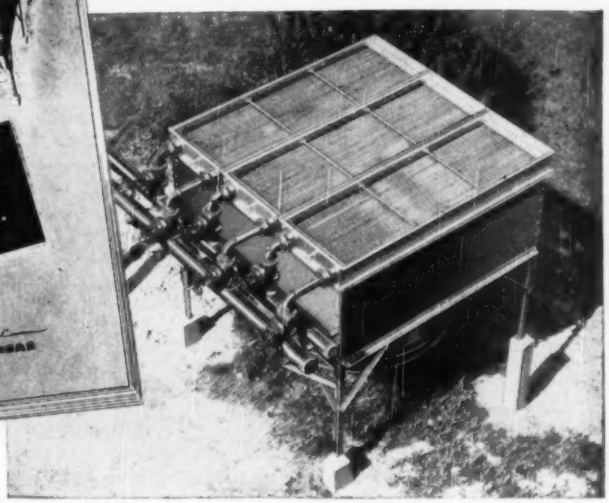
Delco-Remy
DIVISION, GENERAL MOTORS CORPORATION
ANDERSON, INDIANA

DELCO-REMY • WHEREVER WHEELS TURN OR PROPELLERS SPIN

RATINGS & DATA ....YOU'LL WANT



on dry cooling equipment... DriCooler®

Whether you have an engine in a power plant — products to cool or condense in a natural gasoline plant — engines or gas to cool at a gas pipeline compressor station — high level heat dissipation in a refinery or a small standby engine to cool .... Marley has a DRICOOLER to do your job!

Small "packaged" DRICOOLERS or large industrial units are all built to give years of dependable service. All DRICOOLERS, large or small, have finned tubes that are easy to clean, quick to drain and have been tested for long life. Proven Marley mechanical equipment insures smooth, quiet operation.

DRICOOLERS are standard in forced or induced draft, horizontal or vertical coils, steel units or abestos-board covered redwood structures, and sections are available with various fin and tube materials and header arrangements.

WRITE FOR THE NEW DRICOOLER BULLETIN

- **Gives rating tables for cooling water**
- **Lists dimensions and weights**
- **Shows coils, structure and mechanical equipment**
- **Photographs of actual installations**

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Please send me without obligation Bulletin DC-50 on the complete line of Marley DRICOOLERS.

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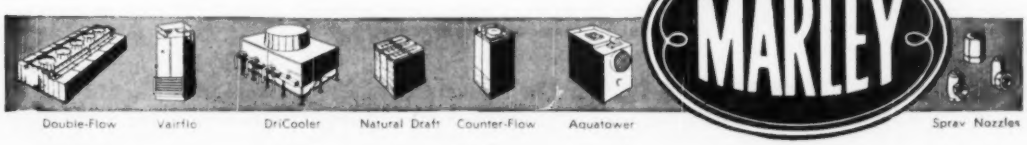
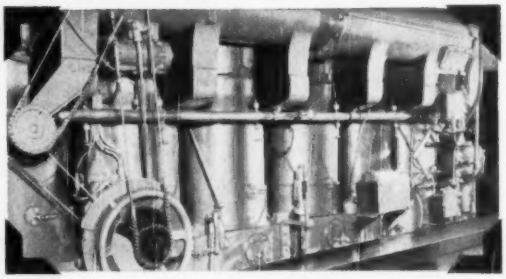


STANDARD ENGINEER'S REPORT

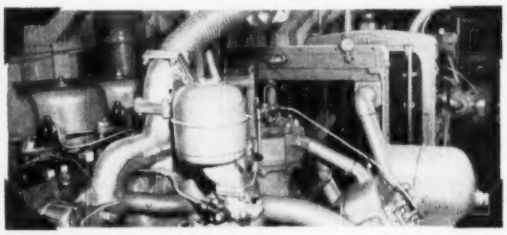
DATA

LUBRICANT RPM Delo Oils
UNIT 275 H.P. Union diesels – 6 cyl. 11"x15" M.V. Komoku
LUBRICATOR Dry sump
CONDITIONS Intermittent operation. Capacity loads against strong tides
PERIOD 12 years
FIRM Bay & River Navigation Co., San Francisco

No stuck rings or bearing failures in 12 years!



HAULING 900-TON-AVERAGE LOADS, the M. V. Komoku's two 275 H.P. high-speed diesel engines have been lubricated with RPM DELO Oils since the vessel was built in 1938. "In all that time," says Chief Engineer R. B. Gibson, "we haven't had ring or bearing trouble. About 5 years ago we pulled the pistons, but there was so little wear we only installed standard rings. We grind exhaust valves yearly, intakes every two years." RPM DELO Heavy-Duty Lubricating Oil keeps these engines clean and lubricated.



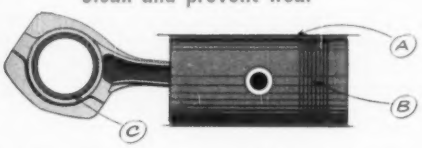
FIVE CATERPILLAR AND BUDA DIESELS are also on the M. V. Komoku to operate air compressors, generators, etc. . . . are lubricated with RPM DELO Heavy-Duty Oil. In varying periods, RPM DELO Oils have prevented ring, cylinder or bearing trouble in any of them.

REMARKS The M. V. Komoku transports sugar from upper San Francisco Bay to various terminals. Strong tide flow, common in the Bay, often makes heavy going for her engines.

RPM DELO Oils are designed to meet every heavy-duty engine need. Besides RPM DELO Heavy-Duty Oil in the Komoku, the other high-performance grades are RPM DELO Special, RPM DELO Supercharged-1, RPM DELO Supercharged-2 Lubricating Oil.

RPM DELO LUBRICATING OILS

How RPM DELO OILS keep engines clean and prevent wear



A. Contain special additives that provide metal-adhesion qualities . . . keep oil on parts whether they are hot or cold, running or idle.

B. Anti-oxident resists deterioration of oil and formation of lacquer . . . prevents ring-sticking. Detergent keeps parts clean, helps prevent scuffing.

C. Special compounds stop corrosion of any bearing metal, and oil foaming in both wet and dry sump engines.

FOR MORE INFORMATION about the proper grade of the new RPM DELO Oils to fit your particular requirements, or the complete line of RPM Lubricants, and the name of your nearest "RPM" Distributor, write or call any of the companies listed below.

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THE CALIFORNIA OIL COMPANY • Barber, N. J., Chicago
STANDARD OIL COMPANY OF TEXAS • El Paso, Texas
THE CALIFORNIA COMPANY • Denver, Colorado

Announcing a New Piston Ring Material

"CYCLAN"

Especially developed for severe service in high duty diesel and gas engines. This superior material has the following necessary qualifications of a good piston ring alloy!

- ✓ *En Value* higher than 20,000,000.
- ✓ *Tensile Strength* in excess of 60,000 P. S. I.
- ✓ *Extreme Resistance* to Property Changes under operating conditions.
- ✓ *High Impact Value* for shock resistance.
- ✓ *High Resistance to Breakage* and the ability to undergo considerable distortion prior to fracture without sacrificing resilience.
- ✓ A Structure that assures excellent wear qualities.

Write for additional information.

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MUSKEGON, MICHIGAN

Sealed Power

PISTON RINGS · PISTONS
CYLINDER SLEEVES

BRYAN, OHIO pioneer user of Diesel Power

Two of the four Nordberg Diesels at Bryan are shown in this view . . . the 9-cylinder, 3600 hp unit and part of the 8-cylinder, 3200 hp unit.

. . . another plant that is

100% NORDBERG POWERED

Up until 1907, the municipal plant at Bryan, Ohio used conventional steam power. But that year Bryan made news by being one of the first municipalities to adopt Diesel Engines for power generation. In the ensuing forty-three years, the use of Diesels at Bryan was steadily increased. It is significant that this pioneer Diesel user gradually replaced the older Diesel and steam units with *Nordberg* Diesels, until today it is an *all-Nordberg* powered plant.

Built in sizes from 10 H.P. to 8500 H.P., in a wide range of gas and oil burning types, Nordberg Diesels offer dependable power at low operating cost to meet almost all municipal and industrial needs. Write for further details, outlining your requirements.

NORDBERG MFG. CO., Milwaukee 7, Wis.

BRYAN'S RECORD OF PROGRESS

1907 —Installed two 225 hp American Diesel Engine Company* Diesels and abandoned steam generating equipment

1911 —Added a 450 horsepower Lyons Atlas Diesel

1916 —Installed 520 horsepower Busch-Sulzer Diesel

1933 —Installed their first Nordberg —a 1500 horsepower unit

1934 —Added their second 1500 horsepower Nordberg

1939 —Installed a 3200 horsepower Nordberg Diesel

1946 —Installed their fourth Nordberg Diesel . . . a 3600 horsepower unit

**American Diesel Engine Company later became Busch-Sulzer, now a division of Nordberg*

P35

BUSCH-SULZER
A DIVISION OF NORDBERG

NORDBERG
DIESEL ENGINES

Here's another hard-working International Diesel Crawler with Purolator Oil Filters as original equipment.

A noseful of dirt can ruin an engine . . .

That pile of dirt is being kicked around . . . but it could turn the tables if it crept into the Diesel's oil stream. It's loaded with abrasives that can knock out an engine—lead to costly repair bills and loss of valuable job-time. It's dangerous stuff that must be filtered out of the oil in a hurry.

Here—as under all rugged operating conditions—you can rely on Purolator Micronic Oil Filters for a complete filtering job!*

Why? Because Purolator's exclusive Micronic element traps abrasives measured in microns (.000039 of an inch) . . . has a revolutionary accordion-pleated design which provides a filtering area up to 10 times that of old-style oil filters.

For fuel oil filtration, this means the complete job so vital because of close tolerances of injector plungers, and the microscopic size of injector tip orifices. And for lube oil filtration, Purolator's greater efficiency assures less wear on hard-working bearings and other vital parts.

We know that Purolators can solve your filtering problem. Let our engineering staff show you how!

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PUROLATOR PRODUCTS INC.
Rahway, New Jersey, and Toronto, Ontario, Canada

Protect your Power with Purolator!

PUROLATOR
MICRONIC OIL FILTER
"FIRST IN THE FIELD OF FILTERING"

The successful use of heavy fuels in any Diesel requires careful planning, particularly if the engine has been originally designed to burn standard fuels. The changes in the combustion phenomena alone warrant close attention, and adjustments must be made to compensate for them.

"Since these changes generally affect the operation of the piston rings, many operators have called in Cook's engineers to make an engine analysis and to submit the recommendations needed to assure maximum availability and minimum maintenance costs.

"These analyses of engines, operating under actual load conditions in the field, have turned up many interesting and valuable facts—facts which could only be obtained by electronically indicating the engines and carefully checking all other phases of operation".

This wealth of information is yours to make use of in getting better performance. You can get it by asking Cook's Engineers to make a "Job-Engineered" survey of your plant before changing rings. In this way, you can be sure of getting rings selected for your specifications.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

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and DIESEL TRANSPORTATION

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Vol. 28 No. 9 September, 1950

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Refueling one of the Pennsy diesel-electric locomotives. The clean, simple installation is a far cry from the coaling and watering facilities necessary with steam engines.

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This is the first of a series of twelve articles, each of which will deal with the application of diesels to a particular industry.

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Expansion Joint of the Month

CHOSEN FOR PERFORMANCE

GENERAL DESIGNS

Zallea Stainless Steel Flexible Connectors are available in two general designs. Figure 15, which has a small corrugation, is made in sizes 4" to 10" inclusive. Figure 8 has a much larger corrugation, similar to that used in Zallea Non-Equalizing Expansion Joints, and is made in sizes up to 72" diameter.

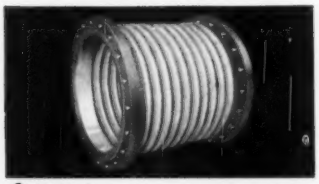


Figure 8

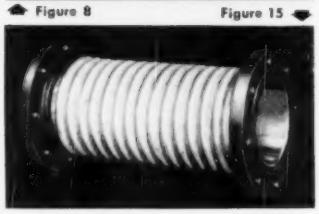


Figure 15

Figure 8 Flexible Connectors are designed to absorb $\frac{1}{4}$" axial movement (5" diameter and smaller $\frac{3}{8}$") per corrugation up to a maximum of $\frac{1}{2}$" traverse with open pitch corrugations and up to a maximum of 3" traverse with close pitch corrugations. Figure 15 Flexible Connectors are designed to absorb .083" axial movement per corrugation up to a maximum of $\frac{1}{2}$" traverse with open pitch corrugations and up to a maximum of 2" traverse with close pitch corrugations.

The supply is going fast . . . send *TODAY* for your copy of Catalog 47, a text book and valuable reference source on all Zallea Expansion Joints.

Zallea Brothers, 812 Locust Street, Wilmington 99, Delaware.

Our Readers Ask

Speaking of flexibility, how do Zallea Flexible Connectors compare with metal hose? J. D. L. —Detroit, Michigan.

Like all other Zallea Expansion Joints, Zallea Flexible Connectors are hydraulically formed and therefore have a uniform wall thickness. All corrugations are annular and parallel, with axis perpendicular to the centerline of the connector. This construction is much more flexible than the spiral or helical form of corrugation found in "metal hose" heretofore used on some of these applications. Zallea Flexible Connectors are formed from tubes having a single longitudinal weld, whereas the type commonly called "seamless" has a spiral weld running around the crest of every other corrugation. This spiral corrugation exerts a torque on the adjacent connections when compressed.

Your inquiries and questions are welcomed. Write to: Engineering Division 917.

ZALLEA RATES FIRST WITH ENGINEERS

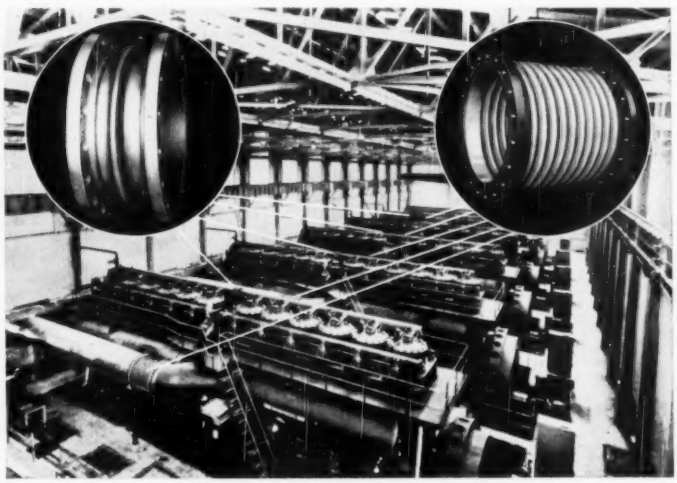
Whether it's a pumping station in India, a power plant in Iceland, or the world's largest Diesel-electric public utility at Tacubaya, Mexico City, pictured below, chances are you'll find Zallea Stainless Steel Flexible Connectors installed on Diesel equipment for full assurance of top performance.

Built For Long Service Life

Here's why: Construction is simplified. Flexibility has been achieved at no sacrifice of durability, which permits bending to a minimum radius of twice the diameter. There are no seams or joints to open . . . no packing required . . . permanently gas tight.

And, Zallea Stainless Steel Flexible Connectors, engineered with annular corrugations, eliminate torsional strains so common to spiral or helical types of connectors.

Zallea Stainless Steel Flexible Connectors are available in diameters from 4" to 72" with flanged or welding ends or a combination of both to handle exhaust temperatures up to 1600° F. If you want to be *sure* . . . always specify Zallea!



Editorial:

Now Is the Time . . .

EVENTS IN Korea have startled and shocked the country, and, in fact, all of the remainder of the world that believes in the dignity and freedom of the individual. If it can be said that any good can come from the shedding of our countrymen's blood, it lies in the fact that our country has been shaken loose from its business-as-usual complacency to a better realization of our actual lack of preparedness.

With so grim a reminder staring all of us in the face, it is inconceivable that any course be followed but to immediately remedy the situation. This means that military expenditures must be stepped up and that we will be living in an armed camp for some time to come. Successful conclusion of the Korean situation — may it come to pass — does not necessarily mean that we can relax. There appears to be no healing of the fundamental breach.

Mobilization, whether we call it that or not, is under way and the degree will largely depend on future events. All industry will be affected and in view of this, let us take a look at our own.

We have no fears for the industry as producers and invaluable contributors even under the most extreme conditions. The last war is too close and the record still stands to confound any doubts. Production increased from approximately 2,725,000 hp. in 1939 to a peak of about 35,000,000 hp. in 1944. And it could do it again — and better.

There is no question but that a military machine is a great consumer of goods and materials of all kinds. Production of these necessities for preparedness will create shortages and consume vast quantities of power. Longer working hours and shift operation will boost the plant service factors. Other phases of diesel usage will be similarly affected, for example, the railroads.

Now is the time to start evaluating your equipment in the light of things that well might come to pass. Diesels have a way of finding themselves in essential industries: the railroads, power generation, oil production, heavy vehicles, water transportation, pipe line pumping, just to name a few. These are essential jobs even in a full war time economy. If capacities are inadequate, if the engines are on the verge of obsolesence, if accessory equipment is about due for replacement, now is the time to get things in shape before world events might tighten the situation.

Harder service and increased hours of operation are going to mean higher parts usage factors figured on a calendar basis. If the criterion is hours or fuel consumed, stocks should be predicated on the anticipated service. In any case, allowances should be made both in stocks and in orders for increased time of delivery.

We hasten to say, at this point, that it is just as silly to over-buy as it is for the housewives to hoard sugar and coffee, thereby depriving someone of his just share and creating local shortages. Each diesel user has to make a decision as to the effect of world events on his particular business and plan accordingly.

One of the major sinews of the Military is oil — fuels and lubes of all types. Here is a field for considerable thought. The Air Forces will require more 100 octane gasoline as they expand. Fortunately jet engines will lower this total as they use fuels of the kerosene type. Regular gasoline will be in demand and when production reaches the maximum, supplies will be diverted from civilian use. The Engineer and Transportation Corps plus the Navy will eat into the available distillates and should supplies run short, house heating will again be curtailed.

About all that is left are the residual fuels and gas. Even the residuals will be in demand for bunkering an expanding Merchant Marine. Obviously, this is no time to be choosy in the matter of fuels. The more serious that things become, the less will be the choice.

This situation suggests two lines for thought. First, the operator should make sure that his equipment is in the best possible condition to utilize fuel and lube oil efficiently. With the latter also in short supply, he should check into filters and purifiers to insure maximum useful life. Secondly, and this is a job for all phases of the industry, a thorough investigation should be made into the use of the less desirable fuels. Also, thought should be given to alternate fuels such as gas and the liquified petroleum gases such as propane and butane.

Now is the time. . . .

From your designs we'll furnish a precision replica in bronze, in standard or special alloy, including helical cuts, chamfers, recesses or tapers. We have excellent facilities for producing a wide variety of simple or complex sizes and shapes in any quantity for many applications, including aircraft, marine, tanks and other military equipment. Laboratory control and inspection methods hold rigidly to your specifications. Research and engineering consultation service is available without obligation. Our seven manufacturing plants also produce a complete line of silent sleeve bearings in many combinations of size, design and materials for a multitude of applications.

Your inquiry is invited.

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FEDERAL-MOGUL

OVER FIFTY YEARS OF CONTINUOUS BEARING EXPERIENCE

+ HIGHLIGHTS +

● American railroads, in the first half of the year, installed 1122 diesel and 5 steam locomotives.

● A Caterpillar Diesel Tractor owned by a farmer in Kansas pulls a cultivator on the farm at a cost of less than 3¢ an acre for fuel.

● F. Perkins, Ltd., Newark, England diesel engine manufacturer, is producing 110 engines per day, of which 30 per cent are being exported.

● American Brake Shoe Company sales amounted to $46,489,716 during the first half of this year and unfilled orders now amount to $16,000,000.

● The American Trucking Association has just published a revised edition of "Economic Giant", a pocket-size statistical reference for the trucking industry.

● Net price reductions up to 25 per cent for six types of all-purpose mercury switches have been announced by Minneapolis-Honeywell Regulator Company.

● Clayton, New Mexico, has found a satisfactory temporary solution for its expanding power needs through the use of two 130-hp. International Automotive Diesels, driving 75 kw. generators.

● The Third Avenue Transit Corporation of New York has placed an order for 60 Mack diesel buses costing $1,100,000. The firm will have approximately 1000 diesel buses in operation when these new buses are received.

● A new price schedule has been announced by the Burgess-Manning Company. The new schedule makes several widely used designs of snubbers available for all types of equipment and installations.

● Nearly two billion dollars will be spent on highway improvements this year, according to the API.

● One hundred per cent dieselized railroads now include the Toledo, Peoria & Western and the Chicago & Western Indiana.

● The Missouri Pacific Transportation Company has operated GM diesels 59,087,455 miles at a maintenance cost of 4.42¢ per mile.

● Morse Chain Company has started to package its complete line of chains and parts, the first complete packaging program in the history of the industry.

● Six new diesel locomotive units of 1000 hp. each have been delivered to the Pennsylvania Railroad. The units are part of the $38 million order placed by the Penn in late 1949.

● Double Seal Piston Ring Company has announced quantity price discounts ranging from 25 to 45 per cent, depending on the quantity of rings ordered.

● The Superior Diesel Engine Division of the National Supply Company has purchased the Atlas Imperial Diesel Engine Co. Superior is moving Atlas from the West Coast to its Springfield, Ohio plant.

● A magnesium-cuprous chloride battery activated by tap water has been developed by the Signal Corps Engineering Laboratories at Fort Monmouth, N. J. It is far cheaper than the 1946 magnesium-silver chloride type.

● Primary aluminum production in May was the highest for any one month since the war's end, according to the Aluminum Association. The Point Comfort plant production may cause production to increase still further.

● New locomotives on order by the railroads on July 1 totaled 1000, which included 973 diesel and 23 steam.

● An order for forty-five diesel-electric locomotives has been placed by the National Railways of Thailand with the Davenport-Besler Corp.

● A new oil refinery has been opened at Pernis, The Netherlands, which raises the refining capacity of that country by one million tons.

● The annual fall general meeting of the American Institute of Electrical Engineers is scheduled for October 23-27 at Oklahoma City.

● An electrical equipment maintenance school was recently held by Westinghouse Corp. for 160 maintenance men from 96 nearby plants at their Hillside, N. J. plant.

● A new documentary motion picture which depicts the round-the-clock role of oil in the modern world has been completed by the Oil Industry Information Committee of the API.

● Baldwin Locomotive Works has announced receipt of orders for 64 diesel locomotive units, including 33 purchased by the Equitable Life Assurance Company for lease to the B & O.

● The Midvale Company has announced that it has received $4,207,171 from the US Treasury on account of claims for refund of income or excess profits taxes paid for years prior to 1946.

● Primary and secondary roads under State control embrace about one-half million miles of the existing three million miles of rural roads. Many of these roads are built and maintained by diesel powered equipment.

Diesels in the Railroad Industry

Cleaning and servicing facilities for diesel locomotives of the Chicago & Northwestern Railway at Chicago.

by George W. Grupp

This is the first in a series of articles dealing with the application and use of diesel engines in this country. This article deals with the railroad industry and contains a brief history of the development of the diesel-electric locomotive and briefly covers several phases of the use of the diesel by the railroads. Several tables of valuable statistical information are included, study of which will give the reader good understanding of the increase in use of diesel-electric locomotives and other diesel equipment by the railroad industry in the past twenty years.

Mr. Grupp, author, lecturer and traveller, who was a professor at Webb Institute of Naval Architecture from 1922 to 1936, Chief of the Trade Routes Project of the United States Maritime Commission from 1937 to 1938, the writer for many trade and technical publications for the past 36 years, and an ardent believer in diesel engines, has been a regular contributor to Motorship and Diesel Power & Diesel Transportation since 1941.

LESS THAN thirty years ago, the diesel locomotive was unknown on the nation's railroads. Steam locomotives were the prevailing type of motive power and were doing a good, dependable job. Moreover, steam locomotives had been serving the railroads for nearly 100 years and were completely accepted by the railroads as well as by the public.

The diesel engine was a comparatively recent entry in the power field in this country and had not gained the wide acceptance as a dependable source of power that it enjoys today in this country. The engine weight and cost per horsepower of diesel engines were excessive and direct drive for locomotives had proved to be unsatisfactory to the railroads. Our engineers and designers had not successfully coupled electric transmission to the diesel engine and, therefore, it was natural for the railroads to discount the diesel.

The diesel engine manufacturers knew that their product would be much more efficient than the steam locomotives if they could find a method of applying the power from the engine to the drivers that would be acceptable to the railroads. Accordingly, one of these engine manufacturers, an electrical equipment manufacturer, and a locomotive maker got together with the idea of producing a diesel-electric locomotive that would perform as well as the traditional steam locomotive and at the

same time give the railroads the benefit of the greater efficiency of the diesel.

In 1925, after several years of experimentation and development, an eastern railroad, which had cooperated with the manufacturers in the development program, accepted the 300-hp. diesel-electric switcher. This switcher which, incidentally, is still in service, was the first practical diesel-electric locomotive built in this country.

About the same time that this first switcher went into service, several more diesel-electric locomotives were introduced to the railroad industry. However, partly because of the indifference of the old railroaders, faulty maintenance, and some mechanical defects, these diesels were relegated to the locomotive graveyard.

The pioneers of the diesel-electric idea were not discouraged by their early failures and continuing research and development soon produced a reliable diesel-electric locomotive which met all the requirements of the railroads and soon established a place for itself alongside the steam locomotive. Some of the results that came from this program included the reduction in weight of the diesels from 60 to 23 pounds per delivered horsepower, increase in life for the electric traction motors from 100,000 to 300,000 miles and extension of engine cylinder liner life from 75,000 to 500,000 miles. In addition, they also increased crankshaft life from 150,000 to 2,500,000 miles and increased the wheel life of the locomotive from 50,000 to 100,000 miles.

As a result of these and other improvements to the diesel-electric locomotives, this type of propulsion power soon became a fairly common sight on the railroads of the nation. At the beginning of the last decade, diesel switchers and passenger locomotives had established themselves as a reliable and efficient form of locomotion, even though their number was still in the hundreds. However, throughout the 40's, their use became increasingly accepted so that, by this year, they were firmly established in these fields of railroading.

Number of Locomotives of Class I and Other Railroads of U. S.

Calendar Year	Steam	Units					
		Diesel-Electric	Electric	Gas-Electric	Gasoline	Others	Total
1929	60,572	25	621	....	....	39	61,257
1930	59,406	77	663	....	....	43	60,189
1931	57,820	80	709	....	....	43	58,652
1932	55,831	80	764	....	....	57	56,732
1933	53,302	85	789	15	35	2	54,228
1934	50,465	104	805	17	30	2	51,423
1935	48,477	130	884	17	31	2	49,541
1936	46,923	175	858	17	34	2	48,009
1937	46,342	293	872	18	28	2	47,555
1938	45,210	403	882	18	29	2	46,544
1939	43,604	639	879	20	28	2	45,172
1940	42,410	967	900	19	35	2	44,333
1941	41,911	1,517	895	20	30	2	44,375
1942	41,755	1,978	892	14	30	2	44,671
1943	41,983	2,476	907	12	26	2	45,406
1944	41,921	3,432	902	17	26	7	46,305
1945	41,018	4,301	885	17	24	8	46,253
1946	39,592	5,008	867	14	25	5	45,511
1947	36,942	6,495	864	14	24	5	44,344
1948	34,581	8,981	867	13	25	7	44,474
1949	Not Available in this form.						

Age of Diesel Electric Locomotive Units Owned By Class I Railroads

Period or Year Built	Freight	Passenger	Freight and Passenger	Switching	Total
Between Jan. 1, 1925-Dec. 31, 1929	....	....	....	16	16
Between Jan. 1, 1930-Dec. 31, 1934	....	....	....	68	68
Between Jan. 1, 1935-Dec. 31, 1939	4	86	....	334	424
Between Jan. 1, 1940-Dec. 31, 1944	806	297	3	1560	2596
Calendar Year					
1945	250	108	7	334	759
1946	214	161	30	246	651
1947	636	378	24	286	1324
1948	1236	267	79	669	2251
Total Active Locomotives	3146	1287	143	3513	8089

Number of Diesel Electric Locomotive Units Installed, Retired, and at the Beginning and Close of the Year for Class I Railroads

Calendar Year	Number at Beginning of Year	Number Installed During Year	Number Retired During Year	Number at Close of Year
1944	2140	919	10	3049
1945	3050	829	67	3812
1946	3857	632	48	4441
1947	4451	1364	43	5772
1948	5836	2272	19	8089
1949	Not Available			

Once having established the fact that diesel-electric locomotives were more efficient and reliable than steam locomotives for passenger and switching applications, the locomotive and diesel engine manufacturers turned their attention to the freight locomotives, which, up to that time, had been the monopoly of the steam locomotives. By effecting certain changes in the design of the existing diesel locomotives and adapting them for freight use, they received ready acceptance of their new product by the railroads. The result of this program was, that by the end of the decade, diesel-electric locomotives were firmly established for use as freight locomotives. Since the initial application to freight use, the diesels have increased steadily in number. This was due, in some degree, to the uncertainty of the coal supply situation but was largely the result of the greater efficiencies and availability of the diesels.

While it appears that steam locomotives will continue to outnumber diesel locomotives for some time to come, economic considerations are causing the steam locomotive to give way steadily to the diesel. The railroads are faced with rising costs and steadily increasing competition from trucks, buses, airplanes and ships, as

well as steadily increasing costs of labor and material. As a result of these factors, the railroads are finding that they must effect economies in their operation and the diesel-electric locomotive appears to be one answer to the problem of how to reduce operational costs.

There is still a considerable amount of activity on the part of the manufacturers of steam locomotives. This activity has taken the form of improvements in the design and construction of steam locomotives to enable them to compete successfully with the diesels. Several new developments have recently been brought forward by the steam locomotive manufacturers, among them the steam-turbine electric locomotive and the geared steam turbine locomotive. Both these types appear to offer certain advantages over the old style locomotives and the diesel-electric locomotive manufacturers are keeping a close watch on their competitors in the steam field as well as waging a continuing fight to improve their own product.

One other new development in the locomotive field which should be mentioned is the gas turbine locomotive. This type of locomotive has been developed by General Electric and American Locomotive and has been on test on the Santa Fe for more than a year. After its first complete year of operation, the locomotive was put through a thorough shop inspection and returned to freight duty. In summarizing the unit's first year of operation, G. W. Wilson, manager of G-E's Locomotive and Car Equipment Divisions, said that during the period the locomotive "performed successfully under almost every conceivable operating condition". Wilson emphasized, however, that the developmental unit must undergo many more hours of rigid road tests before its future as a prime mover can be determined.

Electric locomotives, which were in use before the first diesel locomotive, have many advantages over other types of motive power. However, to be economical, their use is restricted to those areas that have a heavy traffic density. This is because of the large capital outlay necessary for transmission lines or third rails, sub-stations and other equipment. These locomotives have been used for a number of years by several railroads, among them the Pennsylvania between New York and Washington.

Average Hours Per Switching Locomotive-Day of Class I Railroads

Year	Steam	Diesel	Electric
1945	10.5	18.8	12.8
1946	9.8	18.4	12.6
1947	10.6	18.6	12.0
1948	10.3	18.2	12.1
1949	Not Available		

Advantages of the Diesel-Electric Locomotive

Even though steam locomotives possess the speed and power, they are being replaced by diesel-electric locomotives on long fast schedule runs for a number of reasons. First, diesel-electric locomotives can maintain faster schedules on roadway curves and tangents because of their lower center of gravity, lighter wheel loads, and complete absence of dynamic augment. Second since they have no dynamic augment, and are lighter in weight per horsepower when compared with steam locomotives, they reduce track stresses.

Third, diesel-electric locomotives, do not require fuel tenders which are necessary with steam locomotives, yet they are capable of long sustaining runs without refueling since each unit carries enough fuel for 700 to 800 mile runs. Fourth, they use very little water. For example, a 5400 hp. diesel-electric locomotive requires only 900 gallons of water—water that is not wasted since it is continuously recirculated in a closed cooling system during an entire run. In contrast a comparably fast road steam locomotive carries about 30,000 gallons of water in a tender which must be refilled every 250-300 miles of steaming, since the water consumption increases as the speed of the steam locomotive is increased. For this reason railroads had to build costly water troughs along their rights-of-ways so that the steam locomotives on fast schedule runs could scoop up enough water to keep them going between water-tower stations.

Yard Switching Locomotive Hours for Freight and Passenger Services as Performed by Class I Railroads and Terminal Companies

Kind of Locomotive	1949 Number of Hours in Thousands	1949 Percent of Total	1948 Number of Hours in Thousands	1948 Percent of Total	1941 Number of Hours in Thousands	1941 Percent of Total
Steam: coal	20,546	42.63	30,879	55.22	39,590	75.77
Steam: oil	3,265	6.77	4,639	8.30	5,628	10.77
Diesel electric	24,064	49.94	20,039	35.84	6,275	12.01
Electric	288	0.60	330	0.59	716	1.37
Other	27	0.06	27	0.05	42	0.08
Total	48,190	100.00	55,914	100.00	52,251	100.00

SOURCE: Association of American Railroads.

The Distribution of Total Switching Locomotive Hours of Class I Railroads Expressed in Per Cent

Type and Year	Steam	Diesel	Other	Total
Freight				
1941	87.7	11.4	0.9	100.00
1942	85.1	14.1	0.8	100.00
1943	83.1	16.1	0.8	100.00
1944	78.4	20.8	0.8	100.00
1945	74.4	24.8	0.8	100.00
1946	70.7	28.5	0.8	100.00
1947	68.5	30.8	0.7	100.00
1948	64.4	34.9	0.7	100.00
1949	Not Available			
Passenger				
1941	68.7	20.3	11.0	100.00
1942	66.6	22.7	10.7	100.00
1943	65.9	24.1	10.0	100.00
1944	61.7	28.6	9.7	100.00
1945	56.5	34.0	9.5	100.00
1946	50.3	40.2	9.5	100.00
1947	47.7	42.5	9.8	100.00
1948	40.7	48.9	10.4	100.00
1949	Not Available			

In addition to their superior ability to maintain fast schedules, diesel-electric locomotives can be built up with several power units to almost any desired or required horsepower. They are more efficient than steam locomotives on heavy grades and at slow speeds. At speeds up to 30 to 40 miles per hour diesel-electric locomotives have a greater draw-bar pull than steam locomotives. At higher speeds they level off to the same draw-bar pull of steam locomotives.

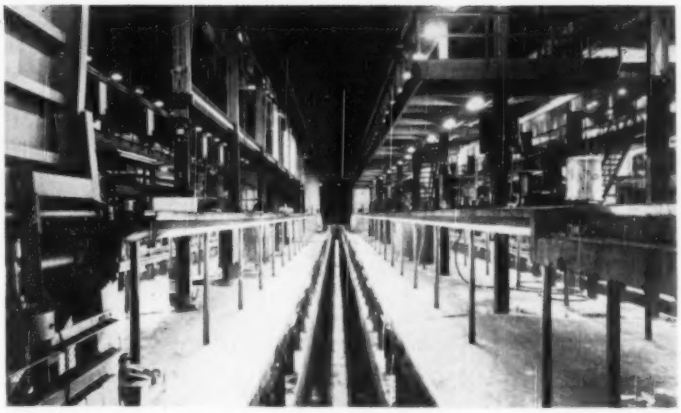
During the cold weather months they are not handicapped as are the steam locomotives by low steam pressure due in part to an inferior grade of coal, or by equipment made defective by the elements such as ash disposal systems, water scooping apparatus and other water facilities.

Diesel-electric locomotives are capable of greater utilization and availability than steam locomotives. This condition reduces the required number of locomotives to perform a definite amount of work. Some diesel-electric locomotives average 25,000 miles per month as compared with 12,000 miles for steam locomotives. And, as a general rule, higher payloads are attainable with diesel-electrics because of their greater overall efficiency.

Growth and Performance of Diesel-Electric Locomotives

From the accompanying tables it will be seen that the total number of steam locomotives dropped from 60,572 in 1929 to 28,309 in 1949 and that the number of diesel-electric locomotive units has increased from 25 in 1929 to 10,973 in 1949. About 85 per cent of the current total number of diesel-electric locomotive units are equally divided between freight and switching services.

Ninety two Class I railroads out of a total of 109 use diesel-electric locomotives. Seven large trunk lines own 32.1 per cent of all the diesel-electric locomotive units in operation. About 5 per cent of the total number of diesel-electric locomotive units are over 10 years of age. And nearly 70 per cent of the total have been in service 5 years or less.



Servicing section of the Pennsylvania Railroad passenger diesel shop at Harrisburg, Pa.

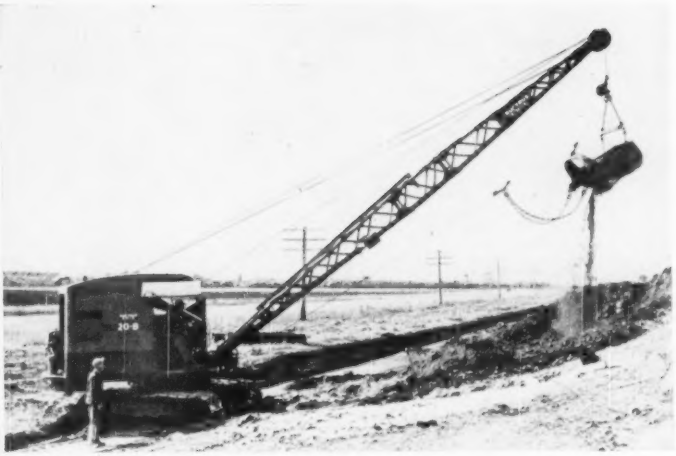
Passenger Train Performance of Class I Railroads
(in thousands)

Item	1948	1947	1946	1945
Train-Miles				
Steam Locomotives	221,007	265,479	327,906	377,090
Diesel Locomotives	127,083	89,469	56,522	38,741
Electric Locomotives	20,282	20,576	23,091	23,496
Road Locomotive Miles				
Steam	234,579	284,943	353,581	401,196
Diesel	130,712	92,430	59,056	41,685
Electric	21,503	21,863	24,890	25,477
Train-Switching Locomotive-Miles				
Steam	462	559	615	649
Diesel	182	111	72	61
Electric	323	329	321	298
Passenger-Train-Car-Miles				
Steam	1,934,377	2,391,779	3,217,109	3,854,372
Diesel	1,418,477	982,739	628,343	437,460
Electric	233,179	233,977	266,227	271,912
Train-Hours				
Steam	6,407	7,600	9,355	10,947
Diesel	2,815	1,965	1,247	843
Electric	442	453	512	530

Two Central of Georgia diesel road switchers pulling a freight train across Lake Martin and the Tallapoosa River near Alexander City, Ala.

On April 1, 1950 the new locomotives on order consisted of 4 electric locomotives, 11 steam locomotives, and 1084 diesel-electric locomotive units. In the first three months of 1950 Class I railroads installed 2 steam locomotives and 432 diesel-electric locomotive units.

During the past eight years, diesel-electric locomotives have steadily increased their railroad performance. For example, the percentage of gross



Diesel powered crawler drag line used for ditching and drainage operations by the Northern Pacific RR.

ton-miles of freight services performed by diesel-electric locomotives rose from 0.22 per cent in 1941 to 34.39 per cent in 1949. Diesel-electric passenger train-car-miles increased from 7.75 per cent in 1941 to 49.29 per cent in 1949.

Diesel-electric locomotives eliminate the time lost at water towers, coal chutes and cinder-pit tracks. As a matter of fact, diesel-electric locomotives eliminate all capital investments for ash pits and cinder handling facilities, boiler washing facilities, and track trough scooping apparatus. They also reduce the amount of capital investments required for water and fueling facilities. For example fueling facilities are reduced 25 per cent by the usage of diesel locomotives.

The fact that there are practically no stand-by costs for diesel-electric locomotives explains in part why the engine hour costs of coal consuming switchers is about three times that of diesel-electric switchers.

When a comparison of water costs is made between steam and diesel locomotives one finds that diesel-electric locomotives reduce such costs to practically a vanishing point since the ratio of direct water costs of diesel-electric locomotives to steam locomotives is about 1: 200.

Freight Train Performance of Class I Railroads
(in thousands)

Item	1948	1947	1946	1945
Train-Miles				
Steam Locomotives	473,438	543,361	536,097	606,550
Diesel Locomotives	101,644	62,637	44,447	35,423
Electric Locomotives	9,457	9,941	9,659	9,617
Road Locomotive-Miles				
Steam	542,009	693,871	613,704	698,305
Diesel	109,182	67,049	47,437	38,139
Electric	12,318	12,547	13,468	13,570
Train Switching Locomotive-Miles				
Steam	46,561	49,817	48,559	50,165
Diesel	4,306	2,703	1,734	1,314
Electric	687	642	634	685
Gross Ton-Miles of Road				
Steam	159,309	173,297	167,549	188,005
Diesel	34,409	21,173	15,685	13,211
Electric	3,157	3,239	3,119	3,222
Train-Hours (including hours at Way Stations)				
Steam	30,857	34,955	34,197	39,159
Diesel	4,731	2,895	2,043	1,751
Electric	556	569	.....	.....

Similarly when one compares the fuel costs of diesel-electric locomotives with steam locomotives one learns that the heat content of one gallon of diesel fuel oil is equal to about 12 pounds of coal. Looking at this from another point of view one observes that the cost per gross-ton-mile or per passenger-car-mile for steam locomotives is about twice that of diesel-electric locomotives.

More profits accrue to the railroads operating diesel-electric locomotives not only because of their savings in fuel costs, but also because of higher availability, greater utilization, lower overhaul costs, lower maintenance costs, efficient parts service of diesel-electric locomotive builders, and long serviceable life of diesel engines.

One railroad discovered that its annual operating cost amounted to $1.1307 per mile with its steam locomotives as compared with $0.9896 per mile with its diesel-electric locomotives. And its annual fixed charges were $1.22 per mile with steam locomotives and $1.11 per mile with diesel-electric locomotives.

Trackage maintenance costs are also reduced by the use of diesel-electric locomotives because with their rotary type of drive they produce considerably less track pounding at high speeds than do steam locomotives.

Since they are less harmful to tracks on curves because of their low center of gravity and rotary drive there is less reason for the reduction of curvature of existing tracks as is essential for maintenance of high speed schedules with steam locomotives.

If diesel-electric locomotives had been employed on the same scale as they are today, 10 to 20 years earlier, the railroads would have been spared large sums of money which they have spent for the reduction of grades.

Inspection and Maintenance of Diesel Electric Locomotives

All diesel-electric locomotives are inspected daily, monthly, quarterly and annually as required by the Interstate Commerce Commission.

In addition to that, most railroads use the progressive preventative maintenance systems as suggested by the diesel-electric locomotive manufac-

Largest Operator of Diesel Electric Locomotives in Each District as of January 1, 1950

District	Name of Railroad	Number Owned by the railroad		Number Owned by all the railroads		Percentage Owned by the largest operator	
		Number of Locomotives	Number of Units	Number of Locomotives	Number of Units	Number of Locomotives	Number of Units
Eastern	New York Central System	463	633	1721	2204	29.9%	28.7%
Allegheny	Pennsylvania	598	828	1234	1607	48.4	51.5
Pocahontas	Chesapeake & Ohio	141	145	141	145	100.0	100.0
Southern	Southern System	286	509	1055	1601	27.0	31.8
Northwestern	C. & N. W.—C. St. P. M. & O.	225	320	1079	1555	20.8	20.6
Central Western	A. T. & S. F. System	444	864	1614	2873	27.5	30.1
Southwestern	Missouri Pacific	130	234	609	988	21.3	23.7
Total		2287	3533	7453	10973	30.6	32.1

turers. They also usually use the builders maintenance forms and record systems.

This means that specific mechanical and electrical items are inspected and repaired at predetermined locomotive hours or miles, in addition to the regular routine servicing such as fueling, lubricating, watering, sanding, and daily checking of the diesel engines, generators, traction motors, air brakes, safety equipment and other parts before the locomotives are permitted to return to service.

Obviously, an important factor for economical operation of diesel-electric locomotives is a sound system of maintenance. Even though the railroads follow the maintenance ideas of the locomotive builders, some railroaders doubt the efficiency of the present system of periodic servicing and the disposition and utilization of worn parts. As a result some are weighing the advantages and disadvantages of maintenance schedules on a mileage basis, an hour basis, an horsepower basis, and a fuel consumption basis. This latter basis is being considered for diesel-electric locomotives placed in a general service pool and not used for regular runs.

When diesel-electric locomotives were first installed by the railroads they were confronted with maintenance and repair problems with no precedents to guide them. New technicians had to be found. New ideas had to be introduced and new facilities had to be provided. Progress was slow at first, but in recent years under the capable management of the railroads' motive power engineers, the guiding hand of the diesel-electric locomotive builders, and the stimulating efforts of the various committees of the American Railway Engineering Association, tremendous progress has been made, and some well equipped and manned diesel repair and maintenance shops and servicing facilities have been established at strategically located points along railroad lines.

Preliminary Analysis of the Distribution of Steam, Diesel Electric and Electric Locomotives of Class I Railroads as of January 1, 1950

Type and District	Steam Locomotives	Diesel Electrics		Electrics	
		Total Locomotives	Total Units	Total Locomotives	Total Units
Passenger					
Eastern	994	209	284	126	126
Allegheny	780	98	190	119	119
Pocahontas	164	12	12	.....	.....
Southern	696	155	267	.....	.....
Northwestern	554	96	188	21	21
Central Western	808	218	470	.....	.....
Southwestern	388	50	85	.....	.....
Total	4314	838	1496	266	266
Freight					
Eastern	3205	358	743	80	80
Allegheny	3792	164	445	144	144
Pocahontas	1206	.....	.....	32	76
Southern	2640	306	680	.....	.....
Northwestern	2481	320	699	37	76
Central Western	3548	439	1430	25	25
Southwestern	1555	965	2678	.....	.....
Total	18427	2552	6675	318	401
Freight and Passenger					
Eastern	195	80	95	.....	.....
Allegheny	.....	14	14	.....	.....
Pocahontas	.....	4	4	.....	.....
Southern	494	63	113	.....	.....
Northwestern	177	16	18	2	2
Central Western	350	28	30	3	3
Southwestern	538	47	51	.....	.....
Total	1754	252	325	5	5
Switch					
Eastern	1495	1074	1082	43	43
Allegheny	859	958	958	45	45
Pocahontas	378	125	129	.....	.....
Southern	841	531	541	.....	.....
Northwestern	487	647	650	4	4
Central Western	474	929	943	35	35
Southwestern	307	350	351	.....	.....
Total	4841	4614	4654	127	127
All Types					
Eastern	5819	1721	2204	249	249
Allegheny	5431	1234	1607	308	308
Pocahontas	1748	141	145	32	32
Southern	4671	1055	1601	.....	.....
Northwestern	3699	1079	1555	64	121
Central Western	5180	1614	2873	63	63
Southwestern	2261	609	988	.....	.....
Total	28809	7453	10973	716	817

Maintenance Facilities

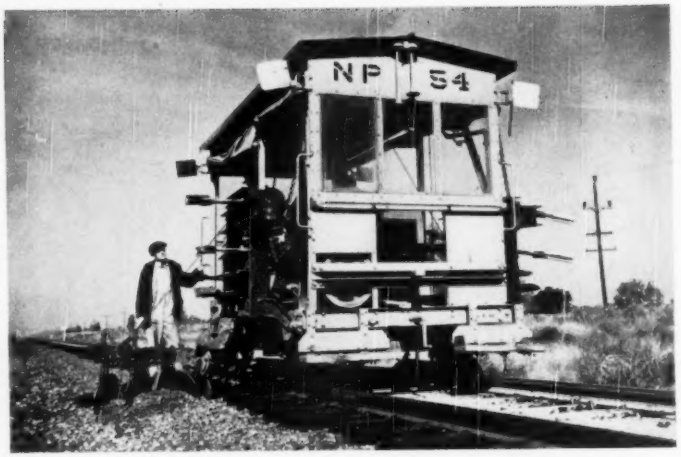
There are two types of diesel-electric locomotive terminals, namely: (1) maintenance terminals, and (2) turnaround terminals. The turnaround terminals are used for inspecting, servicing, and minor repairs. The maintenance terminals are equipped to make heavier repairs.

Sixty-nine railroads which operate 95 per cent of all Class I railroad diesel-electric locomotives and who own about 90 per cent of the total railroad trackage, currently have 280 diesel-electric locomotive repair and maintenance shops which are equipped to perform different degrees of work as can be seen from the following table:

Type of Repairs	Number of Shops
Running Repairs	
Mechanical	271
Electrical	270
Heavy Repairs	
Mechanical	
Engine Overhaul	120
Wheel work	103
Electrical	
Excluding armature winding	50
Including armature winding	19

From this table it will be observed that most railroads are reluctant to spend large sums of money for the construction of shops to make heavy mechanical and electrical repairs. Instead, they are relying upon the locomotive builders for heavy repairs and replacement of parts on a unit exchange basis.

Some railroads have been more courageous than others. For example, diesel-electric locomotive maintenance shops which are prepared to perform practically any kind of repair work are owned and operated by the Atchison, Topeka & Santa Fe at San Bernardino, Cal.; the Central of Georgia at Macon, Ga.; the Chicago & North Western at Chicago, Ill.; the Chicago, Burlington & Quincy at West Burlington, Iowa; the Chicago, Milwaukee, St. Paul & Pacific at Milwaukee, Wis. and Tacoma, Wash.; the Chicago, Rock Island & Pacific at Silvis, Ill.; the Great Northern at St. Paul, Minn.; the New York Central System at Harmon, N. Y.; the Northern Pacific at South Tacoma, Wash.; the Pennsylvania at Altoona, Pa.; the Reading at Reading, Pa.; the Southern Railway at Atlanta, Ga.; and the Union Pacific at Omaha, Neb.



Mechanical tamper used for packing ballast. Use of the machine by the Northern Pacific has saved a great deal in labor costs.

Weighted Average Cost Per Pound of Tractive Effort of New Locomotives Installed By Class I Railroads

Type of Locomotive	1944	1945	1946	1947	1948
Steam					
Freight	$2.562	$2.229	$2.457	$3.106	$3.839
Passenger	1.850	2.144	1.659*	3.534	4.467
Freight and Passenger	3.428	3.664	3.458	.....	.....
Switching	1.412	.....	.....	.....	1.645
Diesel					
Freight	2.125	2.173	2.345	2.498	2.699
Passenger	1.429	3.250	3.300	3.181	3.547
Freight and Passenger	2.926	2.926	.....	.....	2.418
Switching	1.310	1.211	1.366	1.574	1.742
Electric					
Freight	1.030	.....	.....	.....	2.309
Passenger	3.982	7.090	.....	.....	.....
Freight and Passenger	.....	.....	.....	2.783	.....
Switching	.....	.....	.....	.....	.....
Turbo-Electric					
Freight	.....	.....	.....	.....	.....
Passenger	.....	.....	.....	6.085	5.854
Freight and Passenger	.....	.....	.....	.....	.....
Switching	.....	.....	.....	.....	.....

Note: *Only 3 medium sized locomotives

Other Diesel Equipment Operated by Railroads

Railroads do not confine their use of diesel engines to locomotives. Diesel motor trains have already been introduced for suburban mass passenger transportation. These motor trains can operate as single units or can be formed into longer trains, depending upon the volume of traffic.

Some railroads also use diesel engines to produce power and light for their shops, freight and passenger stations and other facilities.

Railroads also operate such diesel powered equipment as locomotive cranes, power shovels, air compressors, track cribbers, snow plows, earth compaction rollers, ballast cleaners, ditchers and other types of maintenance and construction equipment because of their economy of operation and labor saving. For example, power track cribbers have saved from $900 to $1,500 per mile over hand cribbing.

The overall mechanical and performance efficiency of diesel engines, irrespective if they are used as locomotive motive power or for construction and maintenance equipment, is the chief reason for their increasing usage by the railroad industry. They shall continue to increase in usage because of their low cost of operation and maintenance.

New EMD Exhibit Includes Model of—

A Locomotive Dynamometer

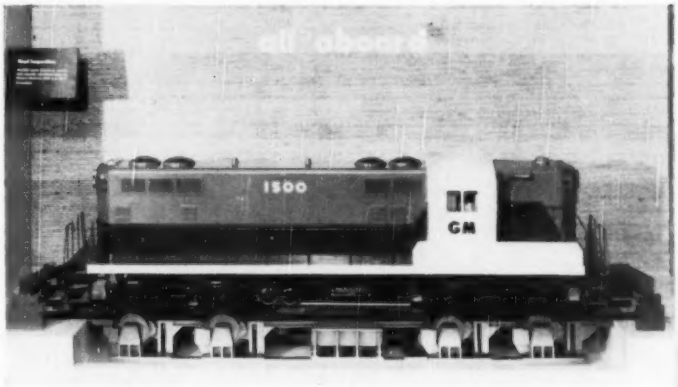
A COMPLEX device such as a diesel-electric locomotive leads to a lot of involved engineering. Each component item must be equally developed so that there are no weak links in the chain. Another point to remember is that, unlike the steam locomotive, there must be a standardized design to permit use of the mass production principle. Following this idea through, such production is dependent on high precision standards unheard of in steam locomotive manufacturing practice.

This engineering development is important but not the whole story. Other considerations include research into styling, product application to customer needs, maintenance and service instruction, availability of parts, and major repair facilities. Introduction of a new type of motive power in an established field also brings up the need for gaining public acceptance—a public relations job. All these factors are important and as in the case of public relations, require the skilled professional approach.

The Electro-Motive Division of General Motors has recognized the necessity of keeping each link in the chain up to the same standard and to point out their achievements along this line have created a new permanent exhibit at their LaGrange plant entitled, "Blueprint for Better Locomotives". This exhibit is designed to show graphically how all the various phases of development were kept in step.

One particular scale model illustrates how the operation of road testing the locomotives has been simplified and put on a mass production basis. Road testing, at both the LaGrange and Cleveland plants, is now being done while the units are standing still through the use of a novel treadmill, or "dynamometer".

The dynamometer is an electrical loading device which enables testing of locomotives under full power through a speed range from zero to 50 mph. Traction motors, attached to the axles of the treadmill wheels, operate as generators while the locomotive is being tested. This permits the dynamometer wheels to be electrically loaded as desired.

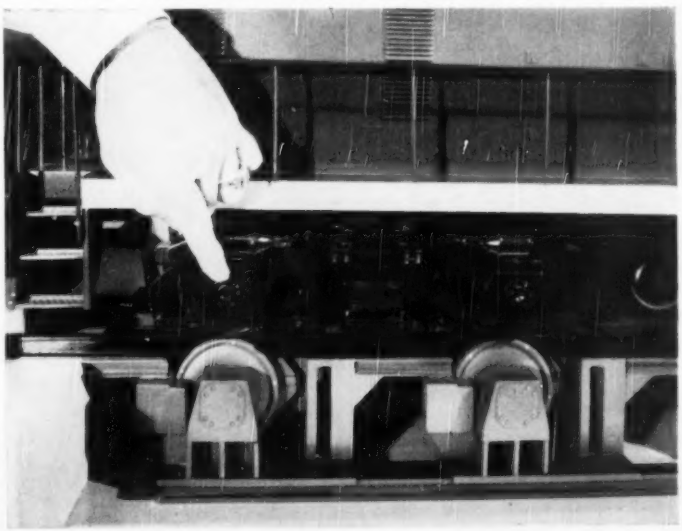


A working scale model of the treadmills used for testing all freight, passenger and switching locomotives. GP7 switcher shown can be put through its paces by manipulation of controls and observation of control panel instruments.

Complete tests are made on the dynamometer, and all relays are adjusted under simulated road conditions, thereby proving the product prior to delivery to the customer.

Besides being able to more critically test locomotives under near-normal road conditions, the dynamometer has reduced testing time by about 25 per cent.

Closeup of the Dynamometer treadmill model, part of EMD's new permanent exhibit. Hand points to treadmill wheel that is connected to traction motor for electrical loading.



Diesel Power for Venezuelan Port

by Sergio Martinez, Jr.
Plant Engineer

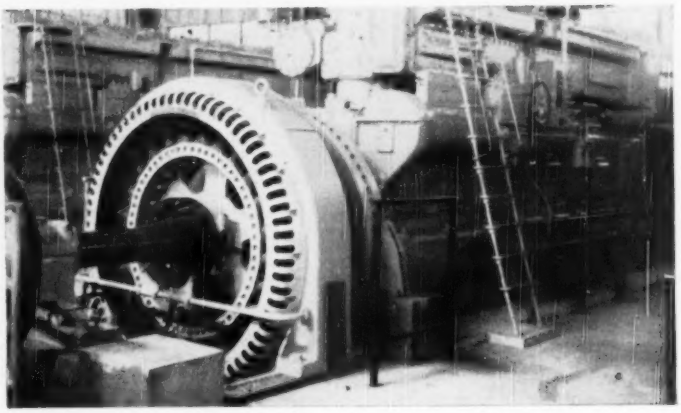
ON THE EAST Coast of Venezuela, right across from Trinidad Island, Frederick Snare Corporation has just finished building "Puerto de Hierro", a transshipment point for iron ore. This port built for Iron Mines Company of Venezuela, a subsidiary of Bethlehem Steel, requires large quantities of power to move the conveyors, unloading towers, ore bridge, machine shop, etc. and to supply this a modern diesel power plant has been erected.

The plant consists of four 2-cycle diesel engines manufactured by Fairbanks Morse which produce 1400 hp. at sea level or 980 kw. per each installed generator. There is also a smaller unit rated 375 hp. or 250 kw. which will be used when none of the industrial equipment is in operation. This unit is also a 2-cycle Fairbanks Morse engine and all five units run at 300 rpm. The generators are 2300 volts, 3 phase, 60 cycles with exciters V-belt driven from the generator shaft.

The units are located in an all-steel building 63 ft. 4 in. wide by 140-ft. long with corrugated asbestos sheets for walls and roof. The layout is very simple and provides for plenty of room around each unit and its auxiliaries making it possible to do any repair work right on the spot. A 15-ton travelling crane traverses the entire building and will be used for maintenance. It has already proven very useful during construction.

The high voltage switchgear is of the metal clad type and is arranged at one side of the building right across from the generators while at the other side are arranged all the auxiliaries, some like the pumps and coolers inside the building and some outside such as the air filters and silencers.

Diesel oil is stored in two large tanks next to the pier and from there pumped as needed to the day tanks of 1000 gal. capacity for the large units and 550 gal. for the small one. Each day tank is equipped with level indicators inside the building. The pumps



View of one of the new 1400 hp. Fairbanks-Morse engines and, below, auxiliary equipment showing (l. to r.) air tanks, air compressor, zeolite softener, oil filter and oil purifier.

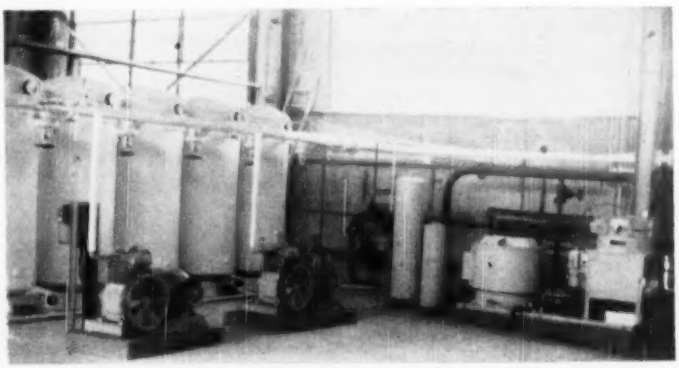
are started and stopped by remote control from the plant.

All the lubricating oil whether new or used is passed through an oil filter and an oil purifier and from there is pumped to elevated tanks inside the building. From these tanks the oil is fed by gravity to a storage tank for each unit. These storage tanks are at one operating floor level and have a float operated valve so as to keep a constant level of oil inside the units.

Cooling of the engine jacket water and lubricating oil is accomplished by means of sea water going through heat exchangers. A pumping station is provided on the beach with the necessary strainers and controls so that all the pumps can be started and stopped by remote control from the plant. An ingenious system of alarms advises the watch engineer in the plant if any of the pumps loses its prime or if anything abnormal occurs. The sea water is pumped first through the oil cooler and finally sent back to the sea. Control of flow in each unit is provided by a temperature actuated control valve in the discharge line.

The water used in the water jackets is zeolite treated and sent to elevated tanks inside the building. From there it flows by gravity as needed to the closed system of each engine. For regeneration of the zeolite softener sea water is used.

Starting of the engine is accomplished with compressed air stored in



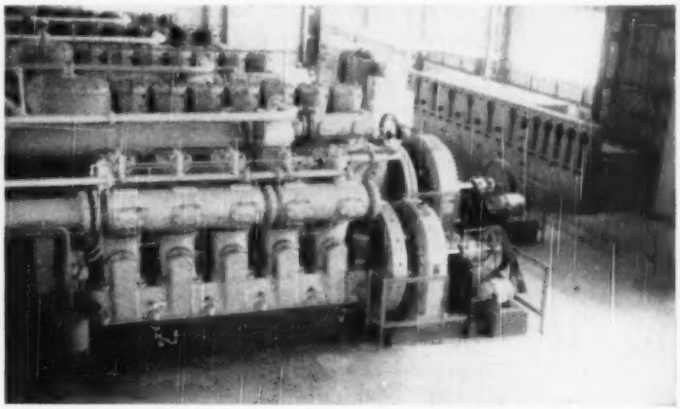
six cylindrical steel tanks located at one end of the building and which are kept under pressure constantly by means of two air compressors, one driven by an electric motor and one driven by a gasoline engine.

sound the general alarm horn and will operate a light in the main control board if any of the following events occur: The cooling water pressure drops; the jacket water pressure drops; the lubricating oil pressure drops; the jacket water temperature goes too high; or the lubricating oil temperature goes too high.

bright colors for the various pipes.

Construction of the plant was started early in the year and the installation of machinery was started in May. The small unit was placed in operation in July, the first 1400-hp. unit was ready in August and the complete plant was finished by the end of November. Operation has been very successful and very good voltage and frequency control are obtained in spite of the frequent starting of induction motors as large as 300 hp. and 400 hp.

DeLaval fuel transfer pumps located next to storage tanks.



General view of the engine room showing the four Fairbanks-Morse engines and generators. Note GE switchboard at right.

All controls for each engine are grouped together at one place. Pressures of the system are indicated as well as temperatures before and after each cooler. A pyrometer provides the temperature of each cylinder. Each unit has five mercoid switches that will

A new color scheme was adopted for the whole plant with light green for all the machinery, light gray for the electrical equipment and different

New York Opens Drive for Diesel Tax Compliance

New York State's Dept. of Taxation and Finance has initiated a new drive for full compliance with the State's motor fuel tax law and regulations by both sellers of diesel fuel and diesel truck operators—including out-of-state truckers who operate in New York.

Through the Department's Miscellaneous Tax Bureau, which administers New York's motor fuel tax law, the State has served notice that tax examiners are checking on diesel fuel sales and use throughout the State.

These are the requirements affecting users of diesel fuel on highways in New York State:

1. If you own one or more diesel powered trucks which operate within New York State, you are considered a distributor under the law and are required by law to register each diesel truck with the State Miscellaneous Tax Bureau. There is a registration fee of 25 cents.

2. You are required to report each month your diesel fuel purchases of the previous month, at the same time paying the State Tax of four cents a gallon on the gallonage reported.

Persons who sell diesel fuel, fuel oil or kerosene for use in the operation of diesel motor powered vehicles are also subject to the law. They are required to report monthly to the Bureau all sales of such diesel fuel, listing the license number of the diesel truck, the name and address of the owner, the quantity of fuel sold and the date of sale.

It is also pointed out that diesel truck owners who fail to file returns or pay the tax on diesel fuel in compliance with the New York law are subject to a penalty of five per cent of the tax plus one per cent for each month of delinquency. Filing "wilfully false" returns is a felony. Other violations of the law or regulations are misdemeanors, punishable, upon conviction, by a fine up to $5000.00, imprisonment for up to one year, or both. In addition, violations may result in the suspension or revocation of diesel registrations and filling station licenses.

In order to apply for registration of diesel trucks, to obtain report forms, and for further information as to requirements, the owners of diesel trucks operating in New York and retail sellers of diesel fuel in the State should write to the Miscellaneous Tax Bureau, New York State Department of Taxation and Finance, Albany 1, N. Y.

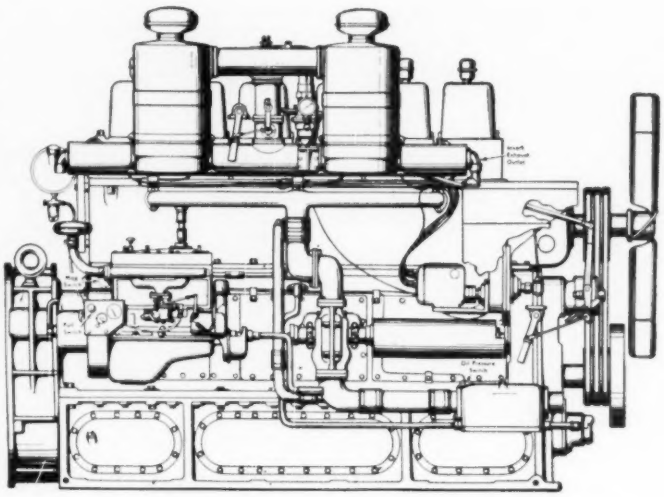
Waukesha Gas Conversion

Two of Waukesha's diesel engines may now convert to gas fuel by using simple field changeover kits.

RECOGNIZING the advantages of natural gas as well as diesel fuel in many types of industrial engine service, the Waukesha Motor Company has announced the perfection of means for quick field changeovers from diesel fuel to natural gas or vice versa of their Models 6-LRD and 6-WAKD diesel engines.

In oil well drilling, for example, an engine user may find diesel oil to be his most economical and convenient fuel in a given location. Later, on moving his drill rig to a different area, natural gas may be the preferred fuel for reasons of availability or price, and to meet the needs in such circumstances, these conversion kits are becoming increasingly popular.

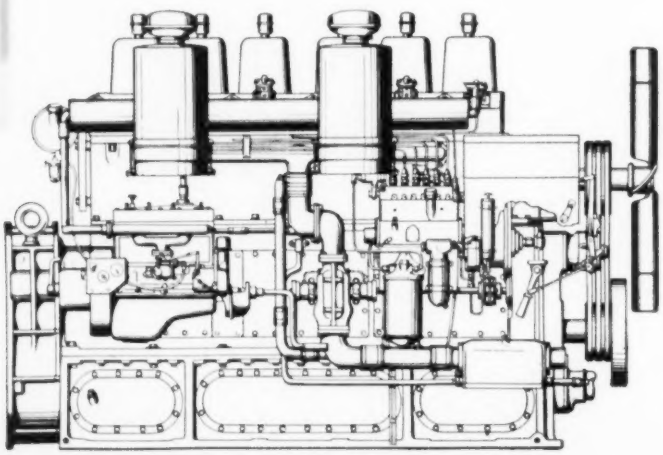
Another common condition arises in metropolitan areas where public service commercial gas consumers enjoy special summer rates that are below the normal winter heating season rates. In such cases stationary engines driving isolated power plants might operate as diesel engines in the winter, and then switch to gas when the summer rates become effective, returning to diesel operation in the Fall. Thus, operation is at maximum economy at all times.



A Waukesha 300-hp. diesel engine converted to burn natural gas. Study of this illustration and comparison with the one below will show some of the changes required in the conversion.

The Waukesha field conversion kits are so simple to use that the operating or maintenance engineer on the job can do the work; and furthermore, engines may be converted over and back as often as required. So complete is the equipment furnished in each conversion kit that no additional expense is entailed beyond the first cost of the kit.

The 300-hp. diesel which can be converted to burn natural gas by using the conversion kit now available. Complete instructions are included with the kit to allow changeover in the field.



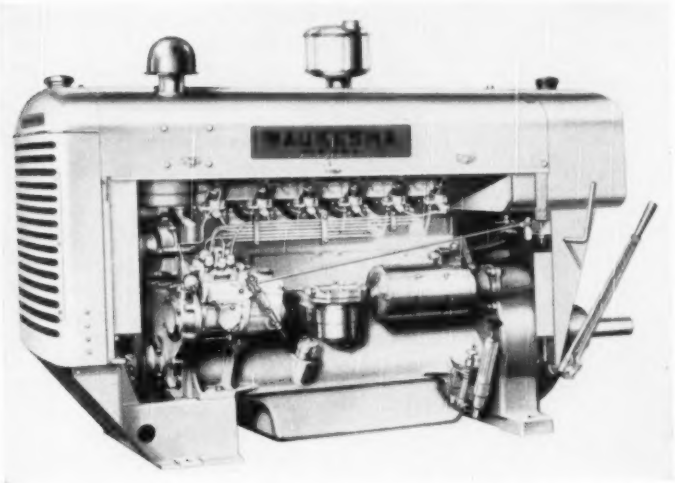
Both the 200-hp. 6-WAKD, and the 300-hp. 6-LRD are converted to gas operation or back to diesel without any internal engine changes. The kits, which are worked out in unusual detail, provide gas cylinder heads, together with the necessary ignition and carburetion equipment. In this regard a spokesman for the Waukesha Motor Research Department explained that the method of using interchangeable cylinder heads to alter the compression ratio was proved, after extensive experiments, to be superior to any other method of conversion. It was pointed out that the time required for the changeover was reduced to a very minimum, and that when the conversion was completed, optimum performance was obtained with whichever fuel was

used. Other methods involving "hybrid" designs were found after extensive tests, to be less efficient in both the diesel and the gas versions.

Some of the outstanding features of the kits include complete plugs, seals, and protective material for the diesel fuel injection equipment and other parts while not in use; new gaskets and hose connections to insure a neat, leak-free conversion job; and substantially built, hinged lid boxes for moving and storing the engine parts. Detailed instructions accompany each kit, showing all converting operations — diesel-to-gas or gas-to-diesel.

This is a very realistic approach to the problems of field conversion. Chances are that with all the seals and plugs readily available they will be used. Under makeshift conditions or complete neglect of precautions, the dirt entering the injection equipment during handling and storage might well cause more damage than thousands of hours of actual operation.

Water-cooled exhaust manifolds, with dual ignition are provided for the Model 6-LRD, 300-hp. conversion, in addition to automatic top cylinder oiling, automatic safety shut-down ignition circuits, and gas carburetors especially developed for top performance. The same details are supplied for the smaller, 200-hp. Model 6-WAKD except that in this case, single spark plugs with one magneto have been found adequate. Such detailed considerations as these are significant of the thorough engineering behind the Waukesha diesel conversion kits.



The Model 185-DACU diesel with a 3-5 16 x 3-3 4 in. bore and stroke. This model has six cylinders and a continuous output rating of 33 hp. at 1800 rpm.

Other Developments

Additional developments include a new series of portable power units built in three basic sizes, a 4-cyl. and two 6-cyl. engines. These basic sizes are made as diesel and as gasoline, butane or natural gas engines.

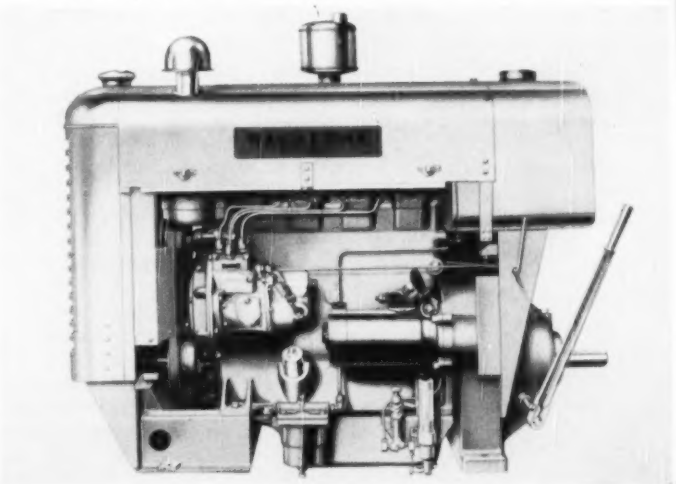
The three diesel power units are designated Models 130-DACU, 185-DACU and 190-DACU and have, respectively, continuous horsepower ratings of 22, 33 and 45 hp. all at 1800 rpm. The first two engines have 3 5/16-in. bores and $3\frac{3}{4}$-in. strokes, the smaller having four cylinders and the larger six. The largest of the three has six cylinders with a bore of $3\frac{3}{4}$-in. and a 4-in. stroke.

Counterpart units designed for burning gasoline, butane or natural gas are interchangeable with the diesels insofar as the mountings are concerned. They are supplied with either gas, gasoline or combination gas-gasoline carburetors. No change other than carburetor and timing adjustments are needed when switching fuels.

Horsepower ratings of the diesels and the gas and/or gasoline units are substantially the same. Interchangeable useable power outputs plus the identical mounting dimensions of each size permit machinery builders adopting this line of power units to offer their customers a wide choice of power with no alteration of the base or drive.

The diesel units are of typical Waukesha design featuring their patented combustion system and having all of the time proven design details associated with these engines.

The four-cylinder Model 180-DACU diesel rated at 22 hp. at 1800 rpm. The bore and stroke of this portable power unit is 3-5 16 by 3-3 4 in.



DIESEL BRIEFS

Huge Diesel Delivered by Truck

Shown above is a new Cooper-Bessemer diesel engine loaded aboard a trailer pulled by a Mack tractor which has been delivered to the International Latex Company, Dover, N. J., a distance of 500 miles from the C-B plant in Grove City, Pa. The engineering feat of transporting the 117,000 lb. monster diesel over the roads is the first of its kind since heavy equipment of this kind must normally be moved on railroad freight cars.

ASME Fall Meeting

The Fall Meeting of the ASME will be held September 19-21 at Worcester, Mass. The program for the meeting has been prepared and distributed. Additional copies can be obtained from the ASME and interested persons may write for additional information to:

Mr. Philip A. Nims
Crompton Knowles Loom Works
Grand St.,
Worcester, Mass.

Of particular interest to persons in the diesel industry are the following papers to be presented: "Convenient Gas Properties and Charts for Gas Turbine Calculations" by Chapman J. Walker, General Electric Co.; "Styling the Machine Tool" by H. S. Sizer and F. H. Burgess, Brown & Sharpe Mfg. Co.; "Design of Lanchester Damper for Elimination of Metal Cutting Chatter" by Robert S. Hahn, Heald Mach. Co.; and "A Report on the Development and Status of Thread Rolling" by A. Bradford Reed, Reed Rolled Thread Die Co.

CPR Delivery

The Canadian Pacific Railway has received from Montreal Locomotive Works the first streamlined diesel-electric locomotive built in Canada for the C.P.R. It is the first such type of a $12,000,000 total order for 58 units which will dieselize the road freight service on the 517-mile Schreiber division between Cartier and Fort William on Lake Superior's rugged north shore. The unit delivered was a 1500-hp. streamlined lead or "A" unit which is equipped with a control cab and is capable of working alone.

Delivery of these diesel-electric units will be continuous through the summer both from the Montreal Locomotive Works and from the newly-built General Motors plant in London, Ont.

Oil Rig Operation

A submersible barge diesel-electric oil well drilling rig has recently completed more than 18,000 hours operation without a major engine overhaul. This unusual record was obtained, it is reported, as a result of the use of the General Electric control system which provides an "infinite ratio gearshift" by means of an electro-hydraulic governor and control system. This equipment provides for matching speed to the load requirement and also prevents engine overloads occurring.

Placed in initial operation in Texas about three years ago by a major oil company, the rig has been using G-E electric drive and associated control. During this long service, maintenance has been kept to a minimum because engine overload, one of the principal causes of engine failure, has been removed through the use of the General Electric electro-hydraulic governor to control the diesel engine which drives the electric generator.

Socony Cat Cracker

Socony-Vacuum Oil Company, Inc., will build a new Thermofor Catalytic Cracking unit at its refinery in East Chicago, Ind., providing a total of eight such units under construction or to be completed during 1950. The construction contract has been let to C. F. Braun and Company.

In every case, the new TCC units with moving-bed catalysts will replace existing Houdry fixed-bed units. They will provide an increase of 50 per cent over the present 10,000-barrel-per-day capacity of each Houdry unit for a total throughput of 120,000 barrels daily of high-quality automotive and aviation gasoline and other products. Each barrel is equivalent to 42 gallons.

In addition, the improved and simplified design which the company developed for its new TCC units will effect substantial reductions in investments and in operating costs, and will increase the flexibility of operations

DIESEL BRIEFS

Monmouth Name Change

The Cleveland Graphite Bronze Company announced recently that the name of its Monmouth Products Division has been changed to the Replacement Sales Division of The Cleveland Graphite Bronze Company.

The Replacement Sales Division thus becomes a part of Cleveland Graphite's general Sales Division and will handle all markets in the replacement field, including N.A.P.A. Sales, Export Sales and Special Markets.

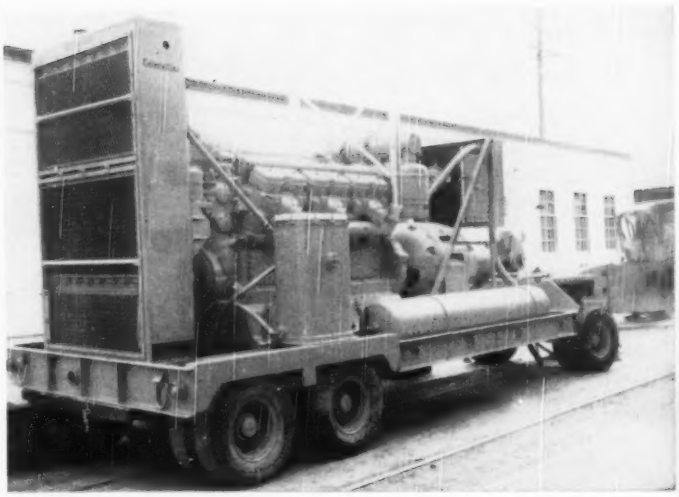
Raymond Z. Oswald, Vice President—Replacement Sales, heads the replacement organization. J. E. Bradley becomes Sales Manager—Distributor Sales, with R. H. Wickersham Assistant Sales Manager—Distributor Sales, while A. M. Currier, Jr., is Sales Manager—Special Markets. W. M. Williams becomes Assistant to the Vice President — Replacement Sales. All were formerly associated with Monmouth Products Company which was acquired last year by The Cleveland Graphite Bronze Company.

Roller Bearing Distribution

Bower roller bearings soon will be available to service outlets through the nation-wide branch facilities of Federal-Mogul Service, division of Federal-Mogul Corporation, according to S. A. Strickland, president of the Bower Roller Bearing Company, and Guy S. Peppiatt, president of Federal-Mogul Corporation, both of Detroit.

"Federal-Mogul's 59 strategically located branches covering the entire United States will provide broad availability for Bower bearings through an old-established and thoroughly experienced organization," said Strickland.

Federal-Mogul Service branches will carry stocks of the complete Bower line of tapered roller bearings, as well as Bower straight roller bearings, which provide replacement coverage of popular sizes in the automotive trade.



Power Package

314,000 watts on wheels rolled out of Interstate Tractor and Equipment Company's Portland, Oregon, shop recently all primed to power J. N. Conley's crushing plants. The prominent local contractor purchased the Caterpillar 12-cyl. V-type diesel engine from Interstate Tractor who mounted the 500 hp. "Cat" on the La-Crosse trailer shown above.

The unit is complete with 314 kw. G-E generator, and panel board with voltage regulator, field control rheostat, ammeter and voltmeter and a phase selector switch and mainline circuit breaker. A gas engine Worthington compressor and two 15-cu. ft. air tanks supply the air for the air-starting motor. Cooling is provided by a Modine radiator of 86-gal. capacity. An external oil filter system allows 1500 hour oil change intervals.

The feature of the trailer power unit, besides its mobility, according to Conley, is that the crushing plants can be electric-motor driven and the diesel power plant can be completely away and apart from the abrasive dirt and dust always present in crushing operations.

This is the third such unit delivered by Interstate Tractor and Equipment Company on portable units this year; the other two are in operation by Rogers Construction Company.

Lancaster Diesel Division

Establishment of an Automotive Diesel Division of Lancaster Engineering Corporation is announced by Irl A. Daffin, company president.

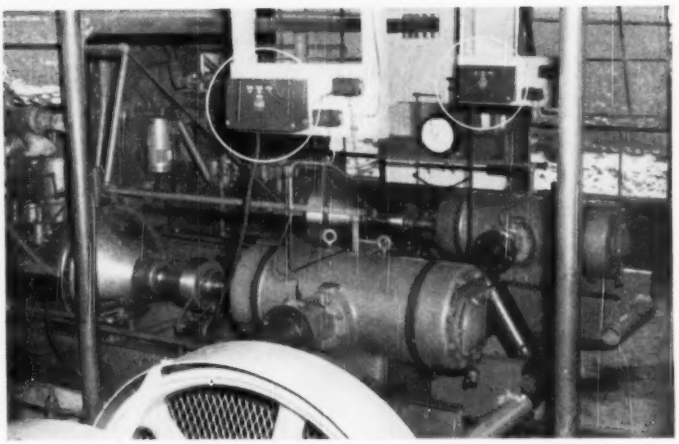
The new LEC division will specialize in the installation of "on-highway" diesel truck engines. The concern has purchased a Brockway tractor and equipped it with a Buda diesel engine for use as a demonstrator.

Company facilities at Lancaster, Hazleton and Philipsburg will participate in the automotive diesel program. John J. Burkholder will be in charge of the new division at Lancaster, with Fred Gardner of Hazleton in charge of the Hazleton branch. Ned Beezer, also of Hazleton, will be in charge of sales in the Philipsburg area.

Service and installation will be handled by R. E. Griffith, service manager at Lancaster, and Guy Stauffer at Hazleton, while Ken Urban will be in charge of installations in the Philipsburg area.

What Automatic Engine Controls Can Do for You

*by C. A. Genske**



Two engine driven rotary compressors with Synchro-Start controls mounted above each compressor (circles).

UNTIL DEPENDABLE automatic engine controls were developed, industrial engines were considerably limited in their use. Even though many of these engines were equipped with electric starting motors and batteries, operators were required. Since the expense of a special operator was not always justified, some other employee was often given the job as an extra duty. This often resulted in real trouble for the man was not always available when the engine was needed, or absent when trouble developed.

To avoid these troubles and secure instant operation when the engine is needed, automatic controls were developed. Engine operation, when combined with one of the automatic control systems, becomes as flexible as the electric motor and often more reliable because it is not dependent on any outside power source which might fail at the most critical time.

These automatic controls have broadened the uses of engines to an extent undreamed of a few years ago. Such engines are now being used for emergency stand-by sets, air conditioning, fire protection, underpass pumping, water and sewage pumping, rural electrification, automotive and marine installations, and an extremely wide variety of other practical purposes.

Types of Controls

Realizing the need for dependable automatic engine controls, Synchro-Start began specializing in them as far back as 1932. Today, all of the various types of controls have proved their reliability and will perform their duty consistently under the most adverse conditions.

These engine control systems will not only start and stop the engine upon demand, but also protect it against any damage while starting and running. They incorporate limited over-all cranking periods, with cycles of cranking and rest to give the engine the best chance to start and to protect the starting system and battery from damage due to excessive cranking. While the engine is running, they will shut it down before any damage can be done because of low oil pressure, overheating, excessive speed, or other dangers to the engine.

If the engine should fail to start in the time allowed, or shut down, a special signal will summon an operator, and will indicate the exact cause of the trouble so that he can correct it without delay. In multiple engine plants, a stand-by engine will immediately start and replace the one that failed.

Controls range from the simplest starting or safety stop set to multiple engine load control panel boards. If only automatic starting and stopping is needed without the safety shut-down provision, various types can be had that will crank the engine, cut out the starting motor after it has started, and shut-down the engine through the operation of any kind of pilot switch. Conversely, safety stop controls may be installed to protect the engine after it has been started manually and can be secured with or without indicating signals to show the exact cause of shut-down. Also, combination units providing automatic starting and safety protection may be secured for complete engine control. In multiple engine plants, complete systems may be installed to automatically start and stop additional engines according to load demand and provide complete protection for each individual engine.

What is the proper type of control? This depends upon the engine, the starting system and the requirements of the installation. However, it has been the experience of users that the small additional cost of a complete system is cheap insurance in the long run — as compared with using elementary types. One breakdown or overhaul caused by neglect or abnormal conditions will ordinarily cost several times more than the additional cost of a complete system that will prevent the occurrence of such damage.

Engines may be conveniently located where they can best do their work and

*Vice President, Synchro-Start Products, Inc., Chicago 14, Illinois.

avoid the annoyance of noise, heat, and vibration, if they are equipped with automatic controls and the proper type of pilot switch. The pilot switch can be of any standard type; it may operate from temperature, pressure, liquid level, power failure, fire alarm, or manually, according to the use to which the engine is put. Operation is controlled from any remote location through the pilot switch.

Stand-by protection or dual drive units are other important uses for automatic engines. The engine and its load may be a separate unit from the electrically driven one, or it may be coupled to the same load through a free-wheeling or centrifugal clutch. Used either way, automatic controls installed on the engine enable it to start and stop according to demand. Thus, if power should fail or the electric motor be disabled, the engine takes over the load, preventing any interruption of service.

In every type of service where it is vital to provide emergency power, automatic starting stand-by generator sets are in great demand.

Multiple Engine Controls

Multiple engine installations are usually preferable to one large unit for power generating purposes, especially in small community utility plants, factories, apartment buildings, hotels, theaters, or office buildings. Modern, standardized electric starting engines frequently reduce the first cost of multiple engine plants to less than that for a single large unit.

It is more economical to operate a number of smaller units, because only as many engines are run at a time as are needed for the load; since each one can operate at peak efficiency. This results in large fuel cost savings and decreased engine wear.

These multiple engine plants reach peak efficiency when such equipment as the Synchro-Start automatic control panels are used to measure the power demand constantly. As additional power is needed, more engines are started, and are stopped when the demand drops, thus keeping exactly the right number of engines running without overloading any one of them. To prevent unnecessary starting or stopping due to momentary overloads or underloads, time delays are used.

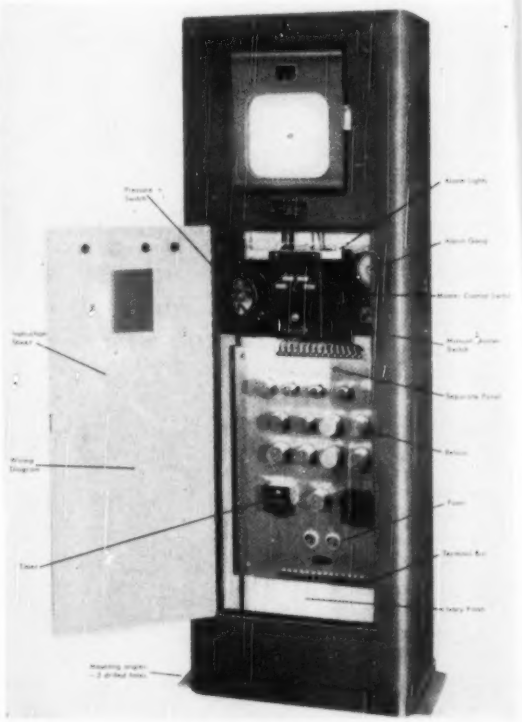
All engines are fully protected against abnormal conditions while running. If an incoming engine fails to start, or a running engine fails, the automatic control panel removes it from service, starts a substitute engine, and gives a signal to indicate the cause of the trouble. By using a selector switch, any engine in the group becomes the lead engine with the others following in definite sequence. This equalizes the wear on all engines. By using individual switches, as many engines as desired may be kept running at all times regardless of load, or shut-down for repair without unbalancing the load sequence.

Incoming alternators may be placed on the line when their voltage and frequency match by means of automatic synchronizers. In some cases it is more desirable to tie all alternators permanently to the line through hand disconnect switches and connect to the engines through free-wheeling couplings. When this method is used, the alternators whose engines are not running operate as synchronous motors at no load or synchronous condensors. Operating in this fashion, they consume very little power and correct the power factor to maintain the plant at or near unity power factor. Then as additional engines are required, they will be started and take over their share of the load.

Similar controls are available for other types of multiple engine plants where variable loads are encountered, with any type of drive. In these cases, the load on the engines themselves can be measured to add more units or drop them out as needed. Transmission is accomplished through free-wheeling couplings or magnetic clutches.

Engines

In general, any engine can be adapted to automatic control, provided it can start readily under all conditions to which it may be subjected and come up to full power and speed quickly without the use of manually operated primers, heaters, glow plugs, compression releases or mechanical



Synchro-Start "Universal" automatic engine controller with front panel opened to reveal component parts.

fuel switchovers. Most modern diesel engines meet these requirements.

Many engines already installed can be successfully equipped with automatic controls, but usually it is better to buy the engine complete with the controls installed at the factory. Since each make and model of engine has slightly different starting and running characteristics, different governor controls are often required for each. The manufacturer knows these characteristics and equips his engine with the proper mechanical units to coordinate with the automatic control system.

Service and Maintenance

After an automatic plant is installed, it must be maintained at peak efficiency to insure that the engine will start readily when needed. If an engine becomes balky and hard to start, an operator can sometimes start it manually by using "special tricks", such as hand priming or special manipulation. Dependable automatic starting, however, depends upon perfect engine functioning, for the controls can not perform those "special tricks", hence it is necessary that the engine always be able to start readily in a normal manner.

Therefore, it is vitally important that engines and batteries be tested and inspected at least once a week. Check the fuel supply and oil level and replenish if necessary. Test the batteries to be sure that the charging rate is correct; that they are fully charged, but not over-charging, and check the water level and specific gravity. On gas or gasoline engines be sure to check the ignition system and breaker points.

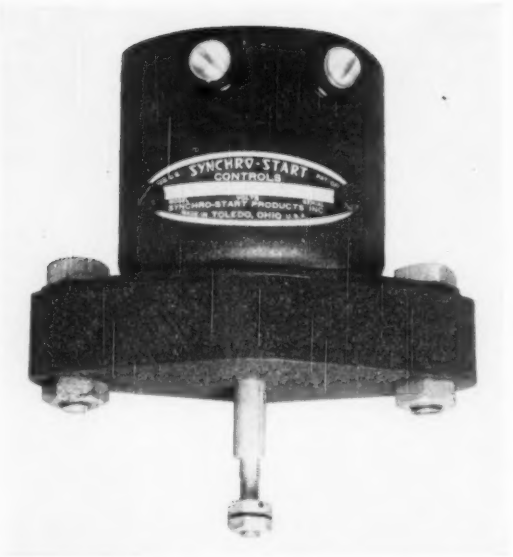
Most control systems need very little service or adjustment of the electrical units and will usually outlast the engine. Merely give them the same care as you would give to any other electrical control equipment, which includes cleaning relay contacts when burned or pitted, and keeping all connections clean and tight. And above all, keep the battery well charged and in good condition.

Test Runs Required

Any engine that stands idle for a few days may be hard to start, refuse to start, or may not be able to come up to full speed and assume its load at once during an emergency. Therefore, all engines should be test-run periodically to circulate the oil and warm the water enough to drive out condensation from the cylinders and crankcase, and to insure that the engine is primed with fuel at all times.

The length of running time varies with different engines, but seldom more than fifteen minutes in length, and should be made at least two or three times a week. Many users maintain a daily test schedule.

Special control systems are available which will automatically start the engine at periodic intervals, run it for a pre-determined length of time and, if desired, provide a record to show the starting times. This feature eliminates the human factor and assures dependable starting at all times.



(right) DC solenoid used for continuous duty operation of throttles, fuel pump racks, chokes and other controls on diesels and (below) safety stop control which acts when oil pressure or overspeed fails or when water temperature becomes excessive.

Conclusion

There are dependable automatic controls which when properly applied will cause the engine to meet practically any special requirements. Savings attendant to the use of such controls will rapidly amortize their cost while at the same time rendering improved and trouble free service.

Maintaining Engine Test Oil

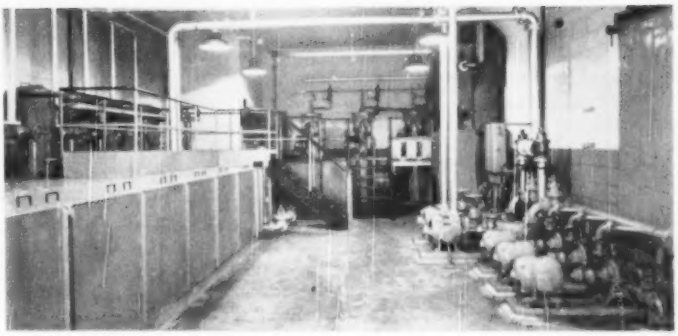
ENGINE manufacturers have long been faced with the problem of testing engines and maintaining a continuous flow of clean oil to the engines on the test floor. Clean oil is a must since, after manufacture and assembly and during initial operation, a certain amount of impurities left in the engine after manufacture and assembly will inevitably appear in the lube oil and, if allowed to remain, will have a harmful effect on moving parts or will score bearings.

Manufacturers maintaining a test floor usually have facilities for testing a number of engines at once or can test engines singly if necessary. When testing several engines, a continuous flow of clean lube oil is required to protect the engines and the amount of oil required is very large.

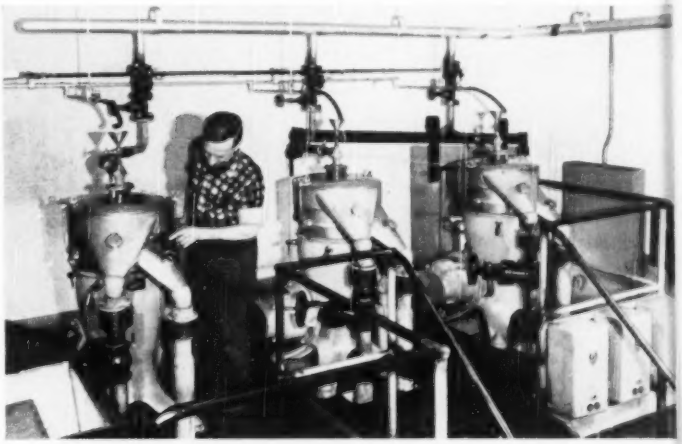
Maintaining a steady flow of clean oil presents some unique problems in cleaning the oil. Filtration will do part of the job and centrifuging will do part of the job but neither filtering nor centrifuging will accomplish the desired end — completely clean oil. The logical solution to this problem would, therefore, seem to be in the combination of filtration and centrifuging to get the benefits of both systems and thus achieve the desired end.

Just such a combination of filtration and centrifuging, the De Laval "*Puri-Filter*", has been available from the De Laval Separator Company for some time. The unit includes a De Laval centrifuge and a Fram filter which provides centrifuging and filtration in one operation.

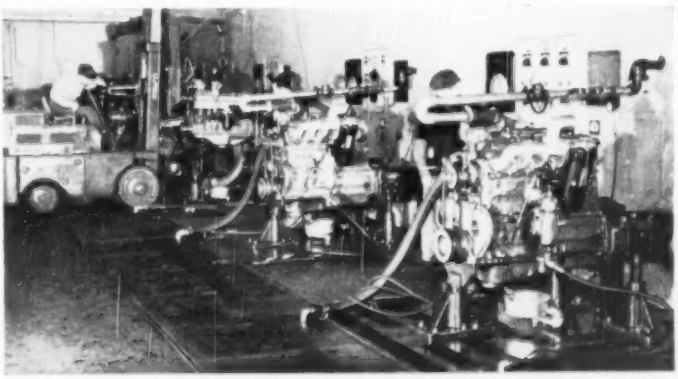
Mack Truck, celebrating its fiftieth year of truck manufacturing this year, is the first firm in the automotive industry to use the *Puri-Filter* idea for maintaining hot block test oil. In its Plainfield, N. J. plant, where all of Mack's engines are made, as many as 34 engines can be tested at once. Whether a single engine or all 34 are on the test block, there is always an ample supply of hot centrifuged and filtered oil available.



Oil purification room of the Mack plant. Settling tanks are at left with Fram filters above them. On balcony can be seen the De Laval purifiers and, at right, are shown two IMO pumps and three centrifugal pumps.



(above) Close-up of oil purifiers on balcony and, below, test stand showing three engines under test. All illustrations courtesy of De Laval Separator Co.



Up to the time that this new block test oil maintenance system was designed, Mack engines had been tested with cold lubricating oil. The procedure had been to fill the crankcase with cold oil, run the engine for 15 minutes with the dynamometer acting as a driving motor, then run for four hours with the engine under its own power and the dynamometer acting as a generator. Power and carburetion were noted during the latter run.

Test Oil Picks Up Particles

During the test, some stray dirt, core sand and metal particles would inevitably be carried through the engine by the test oil. In the process of continuous recirculation of the same lubricating oil for a number of hours, there was always a possibility of damage to running parts, or of scoring bearings.

It was recognized that if a large supply of clean hot oil could be supplied to the gallery of the engine during the tests, all damaging particles could be flushed out of the open crankcase and the green engines could be run in without damage. Moreover, the flushing operation would be facilitated inasmuch as such hot oil could be supplied at a higher pressure and higher volume than normally supplied by the engine lubricating-oil pump.

The ideal system for the purification of the engine test oil would have been continuous full flow centrifugal purification to remove all water and dirt ahead of the full flow filters. In that case nothing much would be left in the oil but colloidal carbon. But there was a total of 18,000 gallons per hour of test oil to purify. To clean this entire volume would require twelve centrifuges each with a rating of 1500 gph.

Further study showed that only a small water contamination would normally be present. Water contamination could take place whenever the water cooling connections were broken at the end of a test stand run. And, if a casting should prove defective in test, there might be a water leak during the test. Some condensation might be expected on the inside of the various oil tanks particularly during humid summer weather. And, finally, the amount of dirt to be removed, in comparison with the oil flow, was expected to be small.

These factors indicated that proper purification of hot diesel engine oil could be achieved without passing all of the oil through centrifuges, if proper settling facilities preceded the centrifuges and filters followed them. The full flow filters would get rid of colloids and any dirt that might remain in that portion of the oil that was not by-passed through the centrifuges. Such an arrangement would be much lower in cost than a full flow centrifugal purification setup, but would provide a plentiful supply of clean, dry, hot lubricating oil to the test stands.

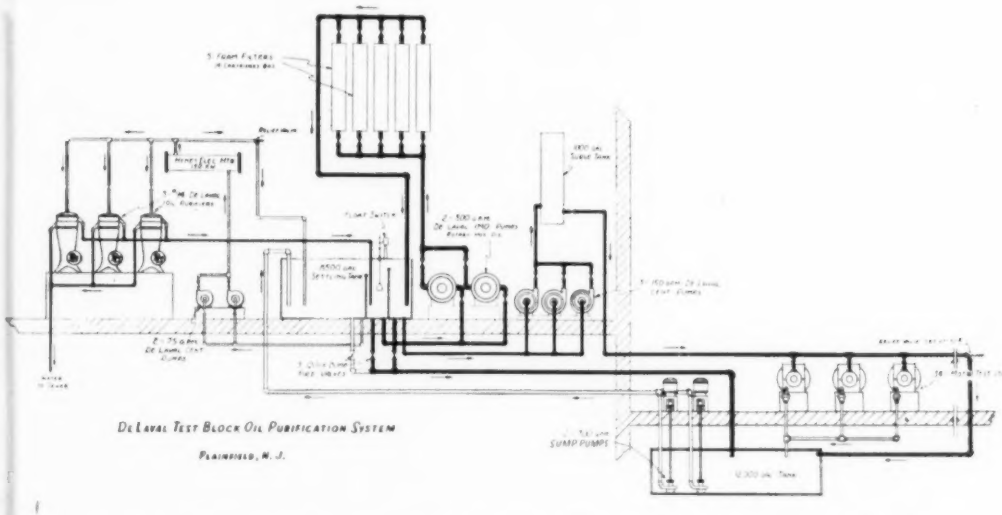
How the System Operates

Oil from the diesel engines on test drops into a 12,000-gal. sump and make-up tank. It is then pumped to an 8500-gal. settling tank in a room above. This tank is designed to allow 30 minutes settling at full flow. This much settling removes the heaviest particles from the oil and permits some moisture to settle out.

At the end of this tank, two baffle-plates are installed. From the front of the first baffle (on the bottom where the water settles) one-quarter of the total quantity of oil— 75 gpm. — is pumped by De Laval *IMO* Pumps through a 180 kw. Hynes heater which raises the temperature of the oil to approximately 160 deg. F. The oil at this point is still wet but now is hot enough to be properly purified.

Three De Laval Oil Purifiers subject the 75 gpm. to the dehydrating effect of centrifugal force. In the bowl of the machine, all water is thrown out and continually discharged to waste, and dirt, core sand or other solids are promptly removed from the oil.

The centrifuged clean dry oil (still containing colloidal carbon) is dumped back into the 8500-gal. tank between



the first and second baffles. There it joins forces with the oil that was not centrifuged, and the full flow of 300 gpm. is then pumped through a bank of five Fram filters, where colloidal carbon and any small particles of solids are removed.

Thus, as the full flow of oil leaves the Fram filters it is clean and dry. It has been subjected first to gravity which is far from good enough to produce clean oil but which acts as a starter. Some of it has been heated, then purified by centrifugal force. And finally it has been filtered. Nothing further is necessary—the oil is now safely dry and clean. It is returned by gravity flow to the compartment of the 8500-gal. tank behind the last baffle-plate, and it is then pumped to a 1000-gal. surge tank inserted to compensate for uneven pressures. From the surge tank, the oil goes to the test stand.

The correct volume of oil is delivered at a constant pressure of 45 psi. It does not make any difference how many engines are on test, the oil will be fed properly under all normal conditions. If the pressure to the stands should drop below 40 psi. an alarm horn sounds and workmen on the test floor shut down the test stands manually.

In case of fire, provision is made through three quick-acting fire valves operated by thermal links to dump all 8500 gal. out of the settling tank. As another safeguard, a float switch in the second compartment of the settling tank shuts off *Purifier* pumps, electric heaters and all feed pumps as soon as the oil level falls below a certain point.

When every engine test stand is in use and a fully supply of clean, dry oil is thereby called for, the quantity of oil circulated through the De Laval Oil Purifiers is, as has been said, one gal. out of four. It is obvious, though, that when only a few stands are running, a greater proportion of the circulating oil can be centrifued. During periods when the stands are shut down, the entire quantity of test oil in the system can be purified.

The system works with the utmost satisfaction. The De Laval's not only dehydrate and free the oil of water and solids; they also cut down the number of replacement cartridges needed by the filters. Exactly as in the case of purifying diesel lubricating oil with the "*Puri-Filter*", this test stand setup, combining centrifugal force and filtration, works better as a team than either method would by itself.

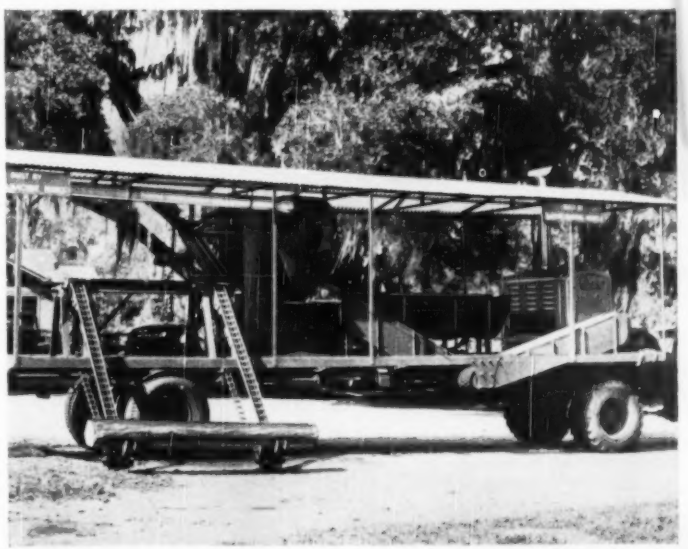
Any plant adapted to using a centralized system of oil supply could use a combination centrifuge-plus-filters arrangement such as this to good advantage. Particularly, plants doing any considerable amount of grinding or cutting should be interested in it, for it is an economical means of obtaining really clean oil in large quantities. This economy extends beyond the first cost to the consistently lower daily cost of maintaining the oil.

Sawmill Goes to Trees

A portable lumber mill, capable of cutting 10,000 ft. of boards per day, recently went into operation in Polk County, Florida. This mobile sawmill, which literally follows chopping crews through the woods turning out rough cut boards at a fast clip may revolutionize lumbering in Florida according to its designer and builder, J. W. Huff of the Bartow Machine Works.

Operated by the Townsend Lumber Company of Lake Wales, the mill is reducing logging costs by cutting down transportation and labor and eliminating expensive permanent installations. The unit consists of a 30-ft. semi-trailer that is towed to its location in the woods by truck or tractor and is ready to operate in just 30 minutes. Its eighteen 24-in. circular saws quickly rip a 16-in. log into one-inch boards $8\frac{1}{2}$ ft. long.

Mr. Huff is particularly proud of the safety factors incorporated in the mill. All gears and pulleys from the 6-cyl. GM diesel engine are built under the floor. Even the saws are completely shielded from workers. A powerful blower keeps the air around the mill almost completely free of sawdust.



The Murphy Dual-Fuel Engine

ADVANTAGES ATTENDANT to the use of dual-fuel engines have now been extended down into the lower range of horsepower and the higher speed engines. The Murphy Diesel Company recently announced three models ranging from 135 to 180 hp. having full convertibility from one fuel to another with no addition or change of parts.

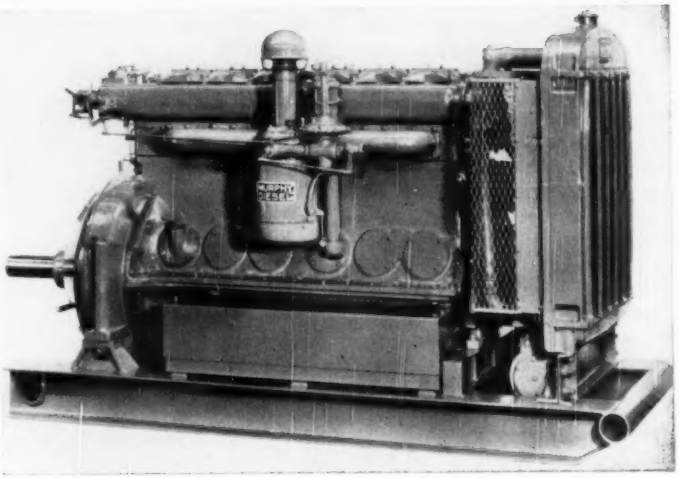
Employing the same basic construction as the Murphy diesels, the new engines are assembled as power units or generator sets. Essentially heavy duty units, they incorporate all the features of the diesel model.

These include Murphy's through tie bolt construction to relieve the frame from combustion stresses, the interlocking connecting rod design with cap bolts horizontal so that large bearings can be used without sacrificing the features of removability through the liner when replacement is necessary, and dual overhead camshafts driven from the flywheel end of the heavy rigid crankshaft.

Other features include the use of four valves for greater scavenging efficiency, improved design of the oil spray cooled piston to eliminate distortion, a hydraulic servo-type governor and full flow filtration of both fuel and lube oil.

The gas system is extremely simple. Gas is fed to the engine through the air cleaner and intake manifold at substantially zero pressure. Pumping action of the pistons delivers a full charge of air every intake stroke and the hydraulic governor controlled gas valve admits just the correct amount of gas to meet the horsepower requirements. The design objective was to insure a lean economical gas air mixture always having an excess of air.

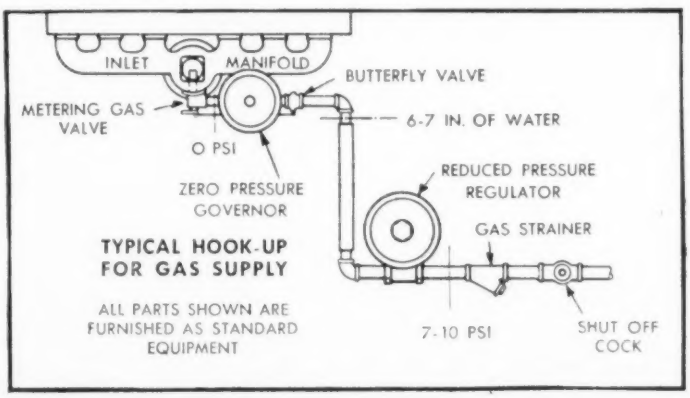
Murphy's own design of unit injector is used to introduce the pilot fuel necessary to start combustion. A constant amount of pilot fuel is used throughout the load range as is the practice in the majority of dual-fuel engines. Also, as might be expected, the smaller, higher speed units are slightly penalized with respect to the quantity of pilot oil required. However, in spite of the minute quantities involved and the rapid time sequences, the maximum amount needed under extreme operating conditions is only 14 per cent. Many of the larger engines are using as high as 10 per cent under normal operating conditions.



Intake side of the new Murphy dual fuel engine. The engine is essentially the regular Murphy diesel. Close inspection will show the gas connection to the right of the breather pipe and details of the gas supply system are shown below.

Conversion of the engines from one fuel to the other is a simple matter of the positioning of a lever in the control linkage. When switching to either fuel, no more adjustments are needed.

In areas where natural gas is available, it is estimated that fuel savings up to two-thirds over diesel operation can be achieved. The cost of gas in a particular locality is, of course, the governing factor. The convertibility feature is attractive since in areas where gas is not immediately available but is anticipated, the engines can be used as full diesels for the present and immediately switched over to gas when it becomes available.



Standardized Teamwork Builds a Pipeline

Pipeline construction is one of the finest examples of team operation —and cooperation—on the American construction scene. New equipment and new methods embodied in well coordinated teamwork set the stage for new production peaks.

Just such an operation is that of the Oman Construction Co., now speeding 3000 feet daily across Eastern Tennessee on the Oak Ridge—Knoxville—Athens section of a new East Tennessee Natural Gas Co. loop. This loop will continue through Chattanooga and Tullahoma and on into Lobelville.

Oman also has the Tullahoma—Lobelville line with N. A. Saigh contracting the Middle Athens—Chattanooga —Tullahoma section. The completion project calls for 325 pipeline miles (mostly 16-inch), of which Oman has 175 miles of mainline and about 75 miles of laterals. The eastern section of the Oman contract, upon which work is now progressing, includes 69 mainline miles and some laterals.

This stretch, at the "Gateway to the Smokies", offers a real challenge to men and machines. The profile varies between 700 and 2500 feet above sea level. Rivers must be crossed. Roads must be trenched through or drilled under. Seventy-five per cent grades must be climbed. Swampy sections must be spanned. Tough, rocky areas must be drilled, blasted, and ditched.

River Crossing

The 1900-foot crossing of the Tennessee River took place well in advance of pioneering operations. When normal pipelaying reached the north bank, river pipe was already laid, backfilled, and ready for tie-in. Here's the way the river crossing was effected:

Fifty-foot sections of 16-inch river pipe were positioned on the north bank for welding into lengths of approx-

(Top) Doping and wrapping the pipe before lowering it into the trench. (middle) Tractor with sideboom cradling pipe after wrapping and doping prior to lowering into trench and, (left) sideboom-equipped tractor spotting pipe after it is unloaded from truck.

imately 400 feet. The pipe, of ½-inch wall thickness, was specially conditioned for its water rest. It first received conventional cleaning and priming; then two coats of enamel dope, two coats of felt wrapping, and a ½-inch asphalt-impregnated, wire-formed felt lagging. Cast iron river weights were clamped on at about 35-foot intervals. There was no need for bending because of the relatively small pipe diameter and the river's gentle cross sectional slope.

Meanwhile, work was proceeding on the cross-channel pipeline trench. A barge-mounted Link-Belt Model 85 Speeder was the center of operations. Both barge and dragline are powered by "Caterpillar" D13000 Engines.

The excavator easily dug a four-foot ditch along both sloping, underwater banks. However, the center section (of 650-foot length and 30-foot depth) provided a knottier problem. Packed mud and rock limited the dragline's effectiveness in this area.

However, a two-foot trench was successfully dug—a perfect resting place for the needed explosives. Twenty-five pound rolls of 80 per cent high velocity river dynamite were tied to a 1½-inch cable and winched into the shallow river ditch. Next, a diver checked the underwater charge—10,000 pounds in all.

At the cry, "Fire in the hole!" a gigantic water wall shot 200 feet into the air, hung seemingly suspended, and boiled slowly down to the river. A quick dragline trip dredged out the loose material in the now deepened channel. Atlas Powder's George Erickson supervised the river shooting.

Next, the first 400-foot pipe section was bullheaded and winched into the river. When this was completed, the next section was rolled over, welded to the first, and winched in. Soon, ends of the connected river pipe awaited tie-in on either bank of the Tennessee.

"Caterpillar" Diesel Tractors proved versatile tools on this crossing. A D8 and D7 with Trackson sidebooms manned welding, doping, and wrapping procedures on the north bank. Meanwhile, on the south bank, a D7 with Hyster D7N winch teamed with a White truck to pull the pipe into its river ditch. Assistance from the sideboom tractors in lifting, jiggling, and pushing the pipe made the winching job easier, surer, and faster.

Pioneering

The main pipeline spread approached the Tennessee River from the north. The river crossing was finished when the pioneering crew had pushed to a point just three miles distant — an example of perfect timing. Operations from pioneering to cleanup extend over a 10-mile length.

Workman using a beveler to prepare section of river pipe for joining in another section.

Three "Caterpillar" D8 Tractors with 8S Dozers perform the pioneering chores — including clearing and smoothing the 50-foot right of way for the oncoming ditching operation.

Ditching

Because of the varying nature of the terrain, the ditching gang includes not only the ditcher itself, but also eight helping machines.

Where possible, a "Caterpillar" D9300-powered Cleveland 320 ditcher cuts out a 28 x 72 in. trench. Two Link-Belt LS-71s and two Lorain L-41s take over on extreme hills, in rocky going, in swampy clay beds, and in widening sidebends. All four three-quarter-yard backhoes have "Caterpillar" D318 engines.

These machines also enlarge the trench to a 6 x 6 ft. size about 50 feet on either side of main road crossings. This enlargement provides access for the drilling machine and extra room for 46-inch under-road casing that surrounds and protects the main pipe string.

In addition, the ditching gang includes a Gardner-Denver twin drill and 500-foot compressor for drilling much encountered solid rock. A "Caterpillar" D13000 diesel powers the compressor; a D6 sideboom tractor swings the drill; a D8 towcat winches the compressor in steep going.

Superintendent Richardson has added a trouble saving wrinkle where ditches follow an uphill course. In these locations, bagging is laid in the ditch to prevent trench-clogging dirt washaways.

Stringing

Oman Construction Co. does its own pipe stringing on this job. Each of five International 190 Series trucks carries twelve 50-foot joints. A "Caterpillar" D6 sideboom tractor unloads one truck in about 18 minutes. A D8 towcat holds or pulls the trucks in steep grade country. When higher stringing production is needed, a "Cat"-powered Lorain L-41 crane helps out.

Pipe Gang

This job marks the first time spiral weld pipe has been given a "stretch" instead of a "wrinkle" bend. The experiment has been successful.

The Coody Cinch Bender moves about 600 feet at a time. Two "Caterpillar" D7 Tractors with sidebooms whisk 50-foot pipe sections to the bender from 300 feet, on either side, and return them to their original locations.

Two more D7s with sidebooms set the pipe on wooden skids and position it for initial welding. There are two welding crews and four welding operations; each operation being a complete 360 degree bead. No tack welds are employed.

The first crew applies a stringer bead and a hot pass bead. Equipment includes a GMC truck with two GM-powered 300 ampere Lincoln welders. The second crew adds filler and finish beads. Here, four Hercules-powered

200 ampere welders do the job.

Eight men handle the arcs: two work each bead, on opposite sides of the pipe. Each welds 180 degrees (his own half) and stays one joint separated from his welding mate.

Dope Gang

Operating about a mile in advance of the main dope gang is an M. J. Crose cleaner and primer. This machine is powered by an International U4 gasoline engine. A D8 with sideboom cradles pipe during this process.

The remainder of the pipe gang includes a Littleford 20-barrel dope pot, a Wisconsin-powered M. J. Crose doping and wrapping machine, three sideboom D8 Tractors and a Sterns-Holiday detecting jeep. Doping and lowering-in are one operation here; the D8s lower pipe into the trench as quickly as it is wrapped.

Pipelining on this part of Oman's contract is complicated by dozens of minor road crossings. A special tie-in crew is maintained to speed overall production and insure fast repair and reusability of roads crossed. A "Cat"-powered Lorain L-41 clamshell, two D7s with sidebooms, and a Ford-truck-mounted 200 ampere Lincoln welder make up this outfit.

Backfill and Cleanup

Two "Caterpillar" D8 Dozers perform the backfilling function. A "Caterpillar" No. 12 Grader cleans and grades the right of way in preparation for resodding. A D6 Traxcavator assists in material spotting and cleanup on steep grades and rocky terrain.

Over the complete sweep of pipelining operations, the onlooker notices a heavy standardization on "Caterpillar" equipment: on tractors, in excavator and ditching power, in compressor power, in marine power. Scope is such that a "Caterpillar" service truck is permanently assigned to the line.

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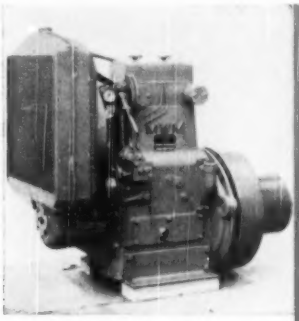

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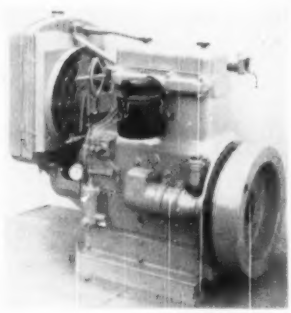

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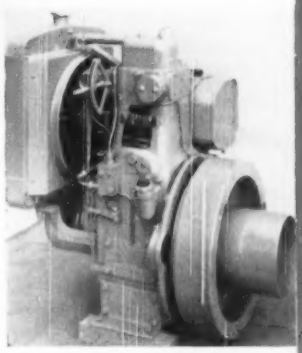

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Some Factors in Determining—

Allowable Oil Clearances

*by W. E. Thill**

EVERYONE is interested in obtaining the best oil clearance as applying to the specific engine he is building: but it is impossible to make a blanket recommendation because of the following factors, enumerated roughly in the order of importance:

1. *The crankshaft finish*
2. *Bearing housing alignment and roundness*
3. *General assembly conditions*
4. *Dirt*
5. *Engine end use*

There are, however, two principles that can be applied in deciding upon the best clearance to use.

The first is to use the oil clearance that is given by the engine manufacturer. If the machining equipment used is accurate enough, and it is also felt that the factors enumerated are as good or better than original manufacturing practices, maintain the minimum clearance recommended: but not below it.

Lacking the manufacturer's recommendation, the suggested minimum clearance to allow for average conditions is shown in Fig. 1.

The second is that the lowest clearance practical is the best, all other things being equal. A bearing is half worn out if set up to some maximum that does not emit noise, but is nevertheless high.

With a large clearance, the oil film is more readily squeezed from under the load, there is a greater tendency toward pounding the lining, and the oil throw-off becomes high making the piston rings work harder to perform the function of removing excessive oil from the cylinder walls.

Adjustments must be made to the oil clearance in an upward direction if any of the five points enumerated are not in keeping with the manufacturing standards.

Service Engineer, Federal Mogul Corporation. Abstract of a paper presented at the Annual Conference of the Automotive Engine Rebuilders Association in St. Louis, Missouri, May, 1950.

About a year ago, the author presented another paper at an Annual Conference of the A.E.R.A. giving some thoughts on the subject of the relation between bearing lining materials and oil clearance conditions. The interest shown in the subject evoked this second paper dealing with the more practical aspects of the same subject.

The salient points covered in the earlier paper are given below as background or supplementary material for this article.

1. That the best oil clearance for a new engine design is calculated, assuming a tin base babbitt bearing.
2. That more oil clearance must be allowed over the ideal for more premium bearing materials based upon experience with them.
3. That there are some areas of very thin oil film bordering upon actual shaft contact with the bearing.
4. That oil flow through the bearing, or throw-off, becomes very high as maximum recommended oil clearances are reached.
5. A "rule of thumb" recommendations for oil clearances for different bearing materials was included.

Recommended Oil Clearances for Various Bearing Materials

For Tin Base and Lead Base babbitts based on
0.0005 per inch of shaft dia.

For Cadmium-Silver-Copper based on
0.0008 per inch of shaft dia.

For Copper-Lead based on
0.0010 per inch of shaft dia.

Fig. 1—Suggested minimum oil clearances for various bearing materials.

Instrumentation is used by manufacturers to determine initially the type of finish obtained after finish grinding a crankshaft. The eye or feel with the thumbnail is no longer acceptable. Both are deceptive. Sharpness of surface and the depth of indentations are somewhat responsible for bearing performance.

Many surface measuring instruments are available commercially: one of them is shown in Fig. 2, the *Profilometer*.

Ground surfaces differ using the same grinding wheel depending upon the intervals between dressings. The type of the wheel or tenacity of the grit to the wheel also affects the final finish obtained.

The importance of shaft and of bearing finishes can be best demonstrated by an example.

Let us assume that a certain engine bearing is set up with an oil clearance of 0.0025 in. but that the shaft becomes eccentric with respect to the bearing hole to allow an extreme minimum film of 0.0001 in. (Fig. 3). This, by the way, is not an impossible condition.

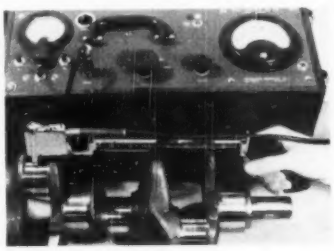


Fig. 2—The Profilometer, used to determine surface finish.

The thin film can be represented by Fig. 4.

Assuming a normally ground, sharp shaft with the bearing bored with a very fine feed, if we allow the oil clearance lines shown in Fig. 4 to become centerlines, a magnified cross

section would simulate that shown in Fig. 5.

It can easily be seen that the 0.0001 in. thin film space is used up by the surface finishes allowing metal-to-metal contact.

The raw, freshly ground shaft surface can readily be made more adaptable by refinishing the surface suitably. The best known and a good method of removing such "fuzz" is by superfinishing. Special machines are available for this, some of which are variations of the original method of using a stone to do the finishing.

The somewhat simple expedient of surface polishing with crocus cloth

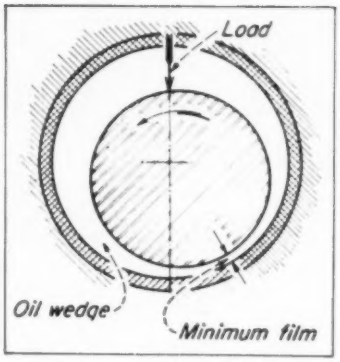


Fig. 3—Exaggerated example of shaft, axis of which has become eccentric with that of bore.

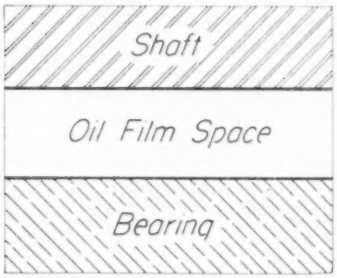


Fig. 4—Enlarged concept of relation between shaft, oil film, and bearing.

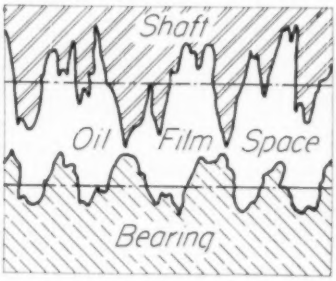


Fig. 5—Magnified cross section of relationship shown in Fig. 4.

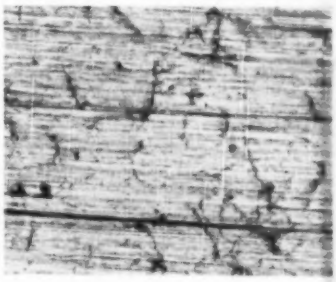


Fig. 6—Enlarged section of checked or crazed shaft surface.

helps immensely. Some crankshaft grinders use emery cloth of 240 grit or finer for this purpose with good results.

Shafts can also be burned by attempting to remove stock too fast. This can have an annealing effect on the shaft surface. They can also become checked or crazed on the surface by the same abuse (Fig. 6).

It has been stated that loads between 2000 and 20,000 psi. are inflicted on the line between the grinding wheel and the work being ground.

Crankcases warp and bearing saddles, whether in the connecting rod or main, also have the tendency to distort. This is more prevalent in some engines than in others. Any engine, however, that has had a bearing failure causing excessive heat generation is open to suspicion.

Without going into the mechanics of why these phenomena occur, the main thing is that they must be corrected.

The warped crankcase can cause a

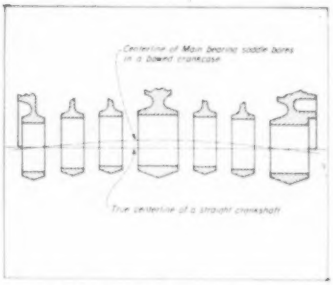


Fig. 7—Bowing effect in saddle alignment caused by warped crankcase.

sag or lift at the ends to cause a bowing effect in the saddle alignment (Fig. 7). Two avenues are open as a means of correction.

The saddles and caps can be realigned by reboring. This calls for some rather precise work.

The usual method is to remove about 0.010 in. stock from the parting face of each cap. The caps are assembled in place and the bolts pulled up to the torque wrench setting. The align boring bar is then adjusted to remove very little stock in the crown of the case half bore as well as remove some in the crown of each cap, and little or no stock adjacent to the parting faces. At the same time, the cutter must be adjusted so that the case is rebored to the original diameter.

The advantage of reworking the case and caps in this manner is that precision inserts can be used and perhaps replaced individually at a later date.

The second method is that of align boring undersized bearings after assembly in the crankcase. This method requires some amount of care in setting up the align boring bar, particularly with regard to maintaining the same camshaft gear relation; but it otherwise simplifies the procedure to still obtain a good sound bearing assembly. The cutting tool, of course, must be sharp and set up to give the required oil clearance with the crankshaft to be used. A fine feed is extremely desirable.

Both methods have merit and each is supported by many enthusiastic mechanics.

Connecting rod bores, particularly, and some main bearing saddles become out-of-round.

With the small oil clearances recommended, the out-of-roundness takes on a new significance.

All connecting rod bores distort to some degree due to various loads inflicted upon them during operation, coupled with continuous heating and cooling from engine use. Some deform more than others, depending upon the structural stiffness of the rod and the loads which are applied.

All connecting rods should be checked for out-of-roundness with the

caps assembled and the bolts pulled up and torqued.

Connecting rods can be reconditioned by removing stock from the parting faces of the cap; bolting up to the torque wrench reading recommended; and regrinding the inside diameter. With care, the center-to-center distance of pin to bore is not altered enough to affect engine performance.

Under general assembly conditions, we have witnessed bearings that were inserted with dirt or cast iron between bearing back and housing bore (Fig. 8). We have witnessed locking lips distorted because they were not seated into their recesses properly (Fig. 9). Improper socket wrench sizes have been used, forcing the cap over to one side (Fig. 10). Also, improper tightening has caused housing out-of-roundness. These and many other errors are unmeaningly performed during an engine rebuild.

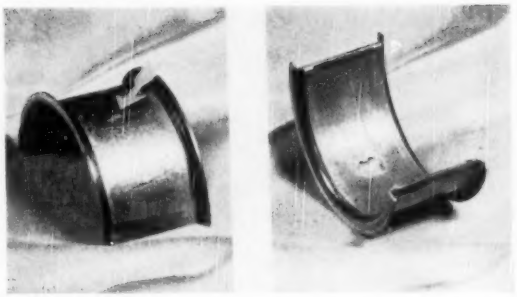


Fig. 8—Bearing which failed because of dirt included between bearing back and housing bore.

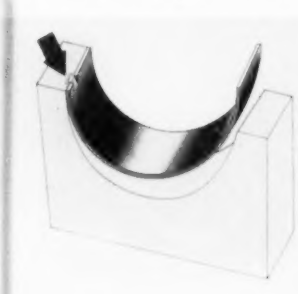


Fig. 9—Inserting bearing insert in proper manner with locking lip properly seated.

Dirt is a major cause of bearing troubles, particularly the dirt left in the engine cylinder block, crankshaft oil holes, cylinder bores, and so forth after metal has been removed. We have had many bearings sent in to us for a diagnosis of the cause of non-performance such as those shown in Fig. 11.

Bearings can put up with slight amounts of dirt such as those due to the by-products of combustion, normal blow-by, and the like. More premium alloys, such as cadmium-silver and copper alloy are more particularly sensitive to such extraneous matter, such as cast iron, steel chips, sand, and grinding grit.

Many engine rebuilders pay particular attention to cleanliness and then allow bare engines, with the cylinder heads and oil pans still off, to be stored in a corner of the same shop where grinding and cleaning of other engines is going on.

Then, too, these same oily, bare engines have been known to be loaded on an open truck and carted across a dirty, windy city to the customer. By actual test, the oily surfaces of crankshaft, crankcase, and cylinders have become coated with grit by that time.

If the customer neglects to reclean the engine, and this now becomes a difficult job, three separate parties eventually become disgruntled over poor engine service life; the customer or user; the middle man, garage mechanic or what have you who final assembled the engine; and the engine rebuilder. Each becomes dissatisfied with the other. Sometimes a settlement between garage man and engine rebuilder takes on major proportions, each blaming the other for something that could have been avoided by merely belting up an oil pan with two capscrews, putting on a cylinder head, and stuffing other openings with good strong wrapping paper or clean cloths.

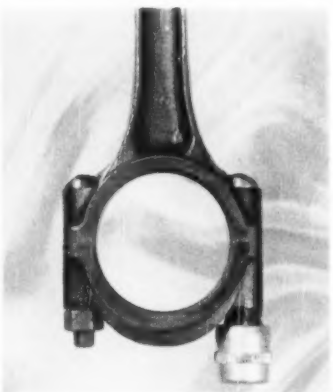
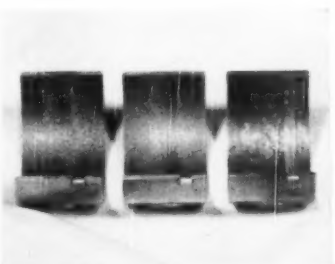


Fig. 10—(above) Cap forced to one side because of improper tool use and (right) Fig. 11—effect of dirt on bearings.



The engine user can be instrumental in the early failure or success of the engine bearings. From the maintenance standpoint alone, engines can be abused by allowing the oil to run low, make insufficient oil changes, never replace the oil filter cartridge, air cleaner, and the like.

In addition, a driver can abuse his power unit, sometimes unknowingly and sometimes deliberately. One of the many ways is by overspeeding or revving up the engine way above the speed for which the engine was designed. This action inflicts terrific loads on the already heavily loaded connecting rod and main bearings.

Then there is the man who insists SAE 50 oil is better than the SAE 10 he should be using; or insists that an SAE 10 should be used when an SAE 50 is recommended. Each affects oil flow through the bearing as well as the throw-off already referred to.

After all, oil must cool a bearing as well as lubricate. Heavy oil retards the flow creating more heat in the bearings. Conversely, too much oil flow excessively lubricates cylinder walls causing other troubles.

Considerations of —
Muffler Design and Application

*by L. H. Billey**

Part II

The second part of a two part article relating to mufflers and exhaust systems used in heavy-duty and off-highway trucks and truck tractors. The first part of this article appeared in the August issue and dealt with the problems confronting the muffler manufacturer and designer and the demands made on him by various persons. Exhaust line elbows, turns and tailpipes as well as muffler location were also discussed in the preceding part. This second part deals with exhaust system function and muffler engineering.

How the Exhaust System Functions

In this series of four illustrations we draw an analogy between the exhaust system and an electrical circuit. We cannot use water flow very well for this purpose. We want to apologize at the outset to those who may not be familiar with electrical phenomena. Likewise, we cannot go into complete and detailed discussions of all phenomena present as this would become a college course in acoustics. So let us proceed, covering the high points first.

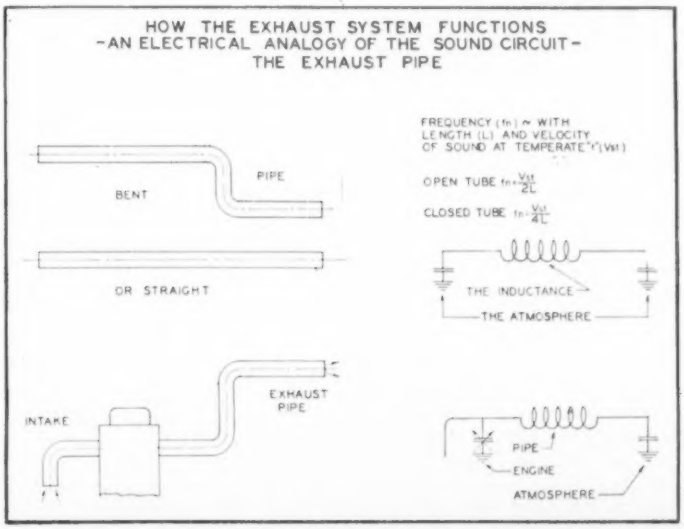
First, let us remember that smooth gradual bends or loops do not alter the sound phenomena in a tube. Whether it be straight or bent, the principle factor is the center-line length of the tube.

Secondly, a most prevalent impression about muffling is that one must subdue the exhaust puffs or "slugs" as they are called, in order to obtain exhaust silencing. There are actually two types of violent "ripples", if we may use such a mild word, in the exhaust system. First, let us consider these exhaust slugs. They travel through the pipe and out at velocities approaching 300 to 400 ft. per second. These slugs represent ripples of large magnitude but low frequency and in themselves would not be difficult to silence. These same slugs, however, set up in the exhaust system more or less stationery ripples with propagation rates of more nearly 2000 ft. per second. These are the sound waves. They have frequencies as high as 5000 cycles per second or 100 times as high as the slug frequencies and these are the "ripples" that the ear recognizes as unpleasant.

Now if we can silence the sound ripples, the slug ripples would not be too unpleasant. Thus in muffling all we need to do is to silence the sound and allow the slugs to pass through freely. The exhaust silencing treatment then becomes similar to the treatment of the ripples in rectified alternating currents as employed by the electronics engineers. He calls these units filters and they usually consist of a coil and condensers or inductance and capacitance. Now a slight change in the arrangement of these same filter elements plus a form of excitation makes an oscillator out of the assembly.

Sound waves in a tube behave much like alternating electrical currents in a coil. They have the same inductive characteristics. In mechanics we might call it "ram" and/or inertia. The atmosphere at the open end of a tube acts like a condenser or surge chamber of infinite capacity. Air confined in a chamber is a "condenser" of lesser capacity.

There are some basic differences too. For example, it is possible electrically to set up sufficient inductive reactance or impedance to reduce current flow to a negligible value. If we could do this with sound, muffling would be a "cinch". Sound will pass



*Project Engineer, Muffler and Silencer Development, Donaldson Company, Inc., St. Paul, Minn. An abstract of a paper presented at a West Coast Meeting of the Society of Automotive Engineers, May, 1950.

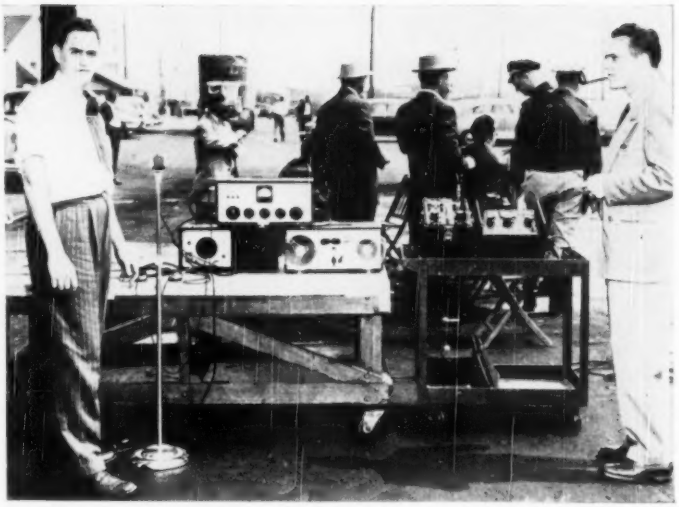
through a tube of great length even if of a high frequency because unlike the electric currents in the coil, the sound wave divides the tube acoustically into shorter unit lengths to satisfy its frequency.

Now let us consider the plain tube, either bent or straight. With some form of excitation such as a stream of air blown across the end of the tube, sound oscillations are set up in the tube. The tube becomes the inductance and the atmosphere becomes the condenser or capacitance, and since they are in series, electrically speaking, a powerful "sonic" oscillator is at work. The steam or air whistle or horn and the pipe organ tubes work on this principle.

Now let us connect the pipe to the engine. The engine serves as an excitation means and acts much like a variable condenser of almost unpredictable characteristics. We now have a sonic oscillator or noise maker with which we are all familiar.

These sound waves set up regions of rarefaction or low pressure and corresponding regions at another point of compression or high pressure. Let us consider an engine of 6 cyl., 4-stroke cycle, running at 2100 rpm. A plain exhaust pipe of 75-inch length or multiples of it will set up a pressure region at the exhaust valves and a region of rarefaction at the outlet end. This pipe length is called a "critical" one. The intake air flow will be reduced as much as 15 per cent, the exhaust will crack sharply, and the engine, if a diesel, may smoke badly. This brings out a most important point. Anything we do to change the character of the exhaust flow shows its influence on intake air flow or scavenging.

If the sound waves are out of phase with the exhaust flow of the engine, scavenging will be adversely affected and, therefore, the new intake charge will be diminished. In muffler engineering then, it is desirable to measure not only back pressure which in itself means very little but also the loss in power if a carburetted engine or smoke intensity if an injection engine and intake air flow and exhaust temperature in all engines. Only then can we tell what influence the exhaust system has on the engine and its components.

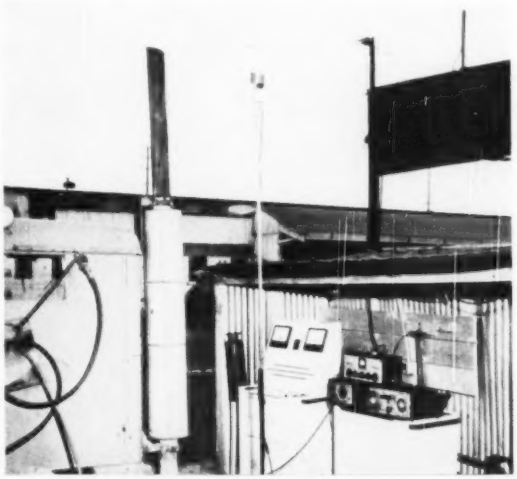


Typical instrumentation stand equipped with a variety of instruments for determining muffling effectiveness. Stands equipped with instruments of this type will be found practically everywhere when a group of persons are to judge muffling effectiveness.

We supply a customer with an intake manifold silencer for a supercharged engine which subdues the blower noise and improves appreciably the intake valve life on these engines. It is not beyond the realm of possibility that many cases of premature exhaust valve failures may be due to adverse sound waves in the exhaust system and not excessive back pressure as is generally supposed.

Since the unmuffled system represents a sonic oscillator, then the muffling problem is one of "sonic" filters". The electronics engineer knows that filtering with resistance only is very inefficient and ineffective. So it is in mufflers, yet many muffler engineers cling to this very method in an effort to silence engine exhaust.

Now we proceed to some basic types of mufflers. In the illustration (a) the baffles are shown with one large perforation in the center. Actually, the back pressure is as high as if this same area was provided in a large number of smaller perforations. Or the single perforation might be



Test being run to determine muffler efficiency and characteristics. The truck is mounted on a chassis dynanometer or some similar apparatus and the engine runs at various loads and speeds to determine the effectiveness of muffling under a variety of conditions.

ptaced off center without much change in back pressure. Also, the back pressure of each successive baffle of equal perforated area is only one-half of the preceding one. Unlike electrical resistors where the total resistance of resistors in series is the arithmetical sum of the parts, in cross baffles the back pressure more nearly approximates X + ½X + ¼X etc. Therefore, when one reaches six or seven cross baffles, the increase in back pressure and the efficiency as a muffler increase very little with additional baffles.

Each chamber between the baffles is a sonic condenser or resonator. Since the area of opening into these resonators is large in proportion to the capacity or volume, the frequency of the resonators is very high. And since they filter out sound frequencies within a limited range of their own frequencies, this type of muffler is effective in silencing in a narrow range of the highest frequencies only.

The electrical analogy is illustrated. The engine, the inlet pipe, the tailpipe and the atmosphere constitute the oscillator or noise generator. The resistance or back pressure of the baffles and the capacitance or the volume of the chambers constitute the muffler or damping unit. One can lower the damping frequency by enlarging the chambers or capacitors, or by increasing the resistance or back pressure. Since back pressure becomes prohibitive in a muffler of reasonable size, this unit has application only on engines which will stand or may require high back pressure in muffling.

The so-called resonator type of muffler has low back pressure and damps out a narrow range of frequencies. It can, however, be designed readily to damp out any desired frequency. The analogy is illustrated. If one had only a single frequency to damp out, this unit could be designed to work very nicely.

We have been talking rather loosely about exhaust noise frequencies. Now to be more specific. The various frequencies in the exhaust noise spectrum of an engine can be calculated at least in part, as follows: the fundamental frequency is equal to rpm. times the number of exhaust impulses per revolution, divided by 1 x 60 for center outlet manifolds and 2 x 60 for end outlet manifolds. The sequence of firing in a conventional engine sets up a beat in the end outlet exhaust manifold which carries thru the exhaust system. An engine of 6 cyl., 4-stroke cycle, running 2000 rpm. has a fundamental frequency of 50 Cps. or 100 Cps. depending upon the exhaust manifold outlet. These are the fundamental frequencies. Now the exhaust system has the characteristics of an open tube so we find in the sound spectrum the 1st, 2nd, 3rd, 4th, etc. harmonics usually diminish in intensity, but occasionally the 2nd or 3rd may be as loud or louder than the fundamental.

As the speed varies these frequencies vary. At slower speeds they are lower. In engines with less cylinders or engines running normally slower, these frequencies are lower. Now the lower the frequency, other factors remaining the same, the larger must be the capacitor or resonator chamber. The higher the speed and the greater the number of cylinders discharging into a common manifold, the higher the frequency and the smaller can be the capacitor or resonator chamber. In 12 to 24 cylinder, 2-stroke cycle diesel locomotive engines, for example, the volume need not be as large proportionately as one would think and the muffling job is easier.

A second series of frequencies starting at 700 Cps. and extending through 2500 Cps. appear in the exhaust spectrum. These frequencies originate in the exhaust manifold and pipe and are more annoying. They are not harmonics of one or two fundamentals but a closely spaced conglomeration of heterogenous frequencies of varying intensities.

A third type of sound pattern occurs when the engine is accelerated. This is of short duration — too short to analyze—but loud and very annoying.

The ear will tolerate the lower frequencies if they are not discordant. This means that the relationship of the frequencies should be harmonious as in music. If the frequencies are discordant or are in the higher ranges, the ear is not pleased. Loudness is a secondary factor. Harmony vs. discord is the primary factor. If one could design a muffler to play a pleasing chord, the loudness or decibel range would not be too important. Any discordant sound which we call noise, if it can be heard at all, is unpleasant to the ear.

Absolute and complete muffling is not practical and is almost impossible, but let's see what happens. A good muffler will reduce the total number of frequencies in the sound spectrum to six or seven and also attenuate these remaining ones to any desired value. These remaining 5 or 6 tones are in the lower ranges, say 50 Cps. to 250 Cps. Each is a pure tone with no superimposed crackle or other faults. They are easy to "listen to" but they now have an hypnotic or sleep-inducing affect on the driver. An unpleasant exhaust noise keeps everybody awake and a pleasant exhaust noise puts even the driver to sleep.

To continue on types of mufflers, let us now turn to the next illustration (b). To increase the frequency attenuation range of the muffler, gaps can be provided at one or both ends. Note the muffler at the upper left. In the electrical analogy we see additional filter elements added to the circuit.

Another and more effective means is shown below. Here we have four capacitors or resonator chambers and a resistor in the form of a cross baffle. These capacitors can be made each of a different frequency to increase the attenuation range. In the analogy at the right, two capacitors were omitted to illustrate how closely a sonic filter resembles an electrical filter.

In the next illustration (c) we see a muffler with no resistors (cross baffles). This is a resonator or capacitance muffler and has the chambers each of a different frequency again to increase the range of frequency attenuation and to do it without back pressure. This type of muffler is necessary in an installation where the three elbows have "used up" all back pressure allowable.

At the bottom you will note a 3-pass muffler and at the right the analogy. These analogies become too complicated to visualize without mathematics. What interests me great-

ly is the fact that the phenomena are comparable, the mufflers can be analyzed electrically, so to speak, and the results check.

How an Engineered Muffler?

Really, it isn't difficult to design an "Engineered Muffler". There are several makes of entirely satisfactory mufflers on the market today for these large trucks. First you procure some equipment, then some instruments and, because you'll need it, you go and get some "know-how". Too many mufflers have been placed in the hands of truck operators with the hope these operators will do some of the engineering.

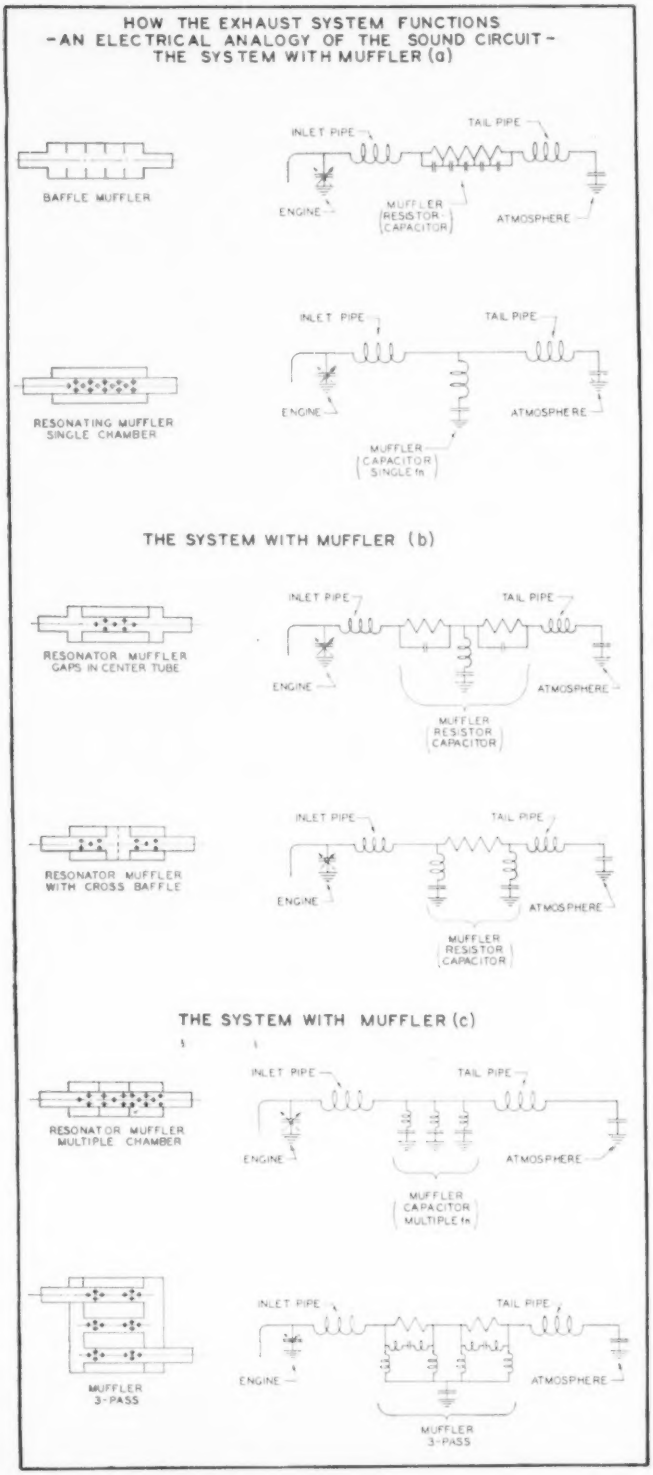
Next, you choose your instrumentation. In muffler engineering there are five phases of test observations. Four are illustrated. The fifth is the "service-life" phase. You can consider and observe all five of these or you can omit a few and pass some others to the muffler users. But every phase is important and it is better to observe and follow through all five of these yourself.

In the weather phase, for example, the barometric pressure variations and temperature variations affect power output of the engine. To determine accurately power loss data from day to day on varied designs of mufflers, you will want to "correct for sea level and standard temperature".

Warm, humid weather with a low ceiling thrown in reduces exhaust noise levels remarkably. Obversely, dry, cold, clear days increase noise levels. So you will want to record these facts, or, if you want to go "all-out", you can set up graphic recorders for most of these observations.

In the power-output phase you have a wide choice of instrumentation. In the box at the right in the illustration we should add specific-fuel consumption equipment. This we have done ourselves recently.

In the sound-measurement phase, too, is a wide choice of instrumentation. The sound-meter boys have an eight-band meter available now to list in the box at the right in the illustration.



The sound-study phase is advantageous because it helps to tell where you are and which way to go next. A good hunch might do the same thing, but this way you can be more certain of your orientation. Add to the box at the right in the illustration an audio signal generator and a stethoscope.

In the service-life phase, instrumentation is a little more difficult, but an engine and dynamometer for cycling the heating and cooling, the weathering and the exhaust gas corrosion, works out well. Mechanical vibrators, preferably with heating and cooling on the engine, interposed at predetermined and regular intervals, reveal a lot of interesting facts. Then you can always place a few on trial test installations with the ultimate users.

"You can't believe your own ears" is certainly an acceptable twist of a well-worn phrase about one's eyes. I don't know much about the mechanics of the ear. This I would like to pursue. In discussing the ear with hearing aid technicians, one learns about hysteresis, selectivity, partial deafness to certain sound frequencies and the like. At the loud levels of noise as in muffler testing, it is better to preserve your ears with sound plugs or cotton and let your instruments do the listening. Recorded sounds played and replayed at levels acceptable to the ear bring out many sounds you could not hear directly.

Auditioning with numerous judges usually fails because they will rate each unit by what was heard just previously. True, they can tell which is better or worse, but how much?

No instrument is better than the person using it and this applies to the soundmeter too. Learn how to use it correctly. Don't misuse it. Check calibration every 3 or 4 hours and it will serve you well.

The sound analyzer and graphic recorder will pay their way too in accuracy of evaluation and saving in time consumed. These sound spectrums or "flag-pole" charts are mighty handy to throw at the boss when he gets inquisitive about how you are progressing. We have made most valuable use of the analyzer on passenger car silencer studies. One can determine, for example, which sounds are created by the cooling fan, which by the engine intake, which by the exhaust system, which from metallic vibration of the silencer, and so on. In muffler work it aids us in determining which frequencies are pure tones and which are not. A series of pure tones are not "hard to listen to" but frequencies with superimposed crackles are.

One of the most useful instruments we have is our facsimile tape recorder. By the word "facsimile" is meant that all frequencies in the sound spectrum are recorded undistorted and in their true intensities and rates. One can "take a run" from an engine test and in the laboratory he can study and analyze any portion of it over and over again as may be necessary.

Now a word about back pressure. This to me is the most difficulty measurement one has to determine in this muffler engineering activity.

At this point I would like to discuss the manometer and why it is not satisfactory for measuring the tax imposed on the engine by the muffler. We have discussed the presence of standing sound waves in the exhaust system. Somewhere along the system will be a node and somewhere else an antinode. These points change with change in frequency, which means a change in speed. They change with change of muffler. They change with change of pipe length. These sound waves with their nodes and antinodes also exist in the manometer tube, which, upon connection, becomes a part of the exhaust sound circuit. Now, since there is a variation in pressure between the nodes and the antinodes, and since one cannot readily tell where these regions are, then one cannot tell whether he is measuring on the crest or in the valley or somewhere in between. And with so many unknowns, how can one depend upon the manometer?

In the reference made earlier where we discussed the 75 in. critical length of exhaust pipe with engine smoking and exhaust cracking, and a lowered intake air flow, a manometer placed in the region of the exhaust manifold flange actually showed a negative back pressure at this point. Exhaust temperature was elevated. So everything points toward a tax on the engine except the manometer. Can we trust it?

(This is the second and concluding part of a two-part article by the author. The first appeared in our August issue. Ed.)

INSTRUMENTATION

TEST OBSERVATIONS	BASIC DEVICES	ENGINEERING DEVICES
WEATHER PHASE TEMPERATURE PRESSURE HUMIDITY CEILING	THERMOMETER BAROMETER HYGROMETER OBSERVED BY EYE	GRAPHIC RECORDERS
POWER OUTPUT PHASE POWER SPEED BACKPRESSURE EXHAUST TEMP SMOKE	DYNAMOMETER REVOLUTION COUNTER MANOMETER PYROMETER RINGELMANN CHART	STROBOTAC CRONOTACHOMETER ELECTRO-PRESSUREGRAPH SMOKE METER
SOUND MEASUREMENT PHASE INTENSITY QUALITY	BY EAR, WITH OR WITHOUT COMPARATOR	SOUND METER VIBRATION PICK-UP SOUND ANALYZER GRAPHIC RECORDER 3-BAND SOUNDMETER
SOUND STUDY PHASE	BY EAR	FACSIMILE TAPE RECORDER AND REPRODUCER PLUS SOUND METER AND SOUND ANALYZER

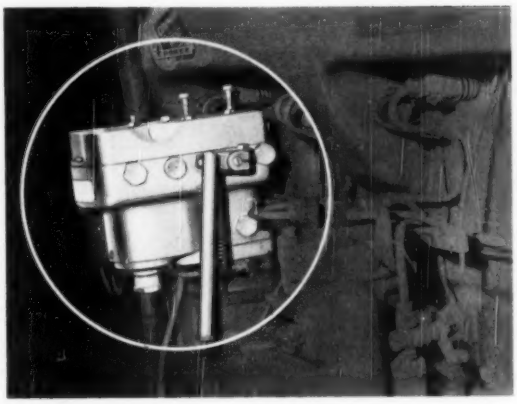
New Woodward Governor

Controls both input and output power in torque converter applications

THE INCREASING use of torque converters as transmissions in excavating and hoisting machinery has opened up an interesting new field of governor application. The first of these was made about ten years ago but only recently have there been any number of installations in which converter output shaft speed as well as engine speed has been governor controlled.

This type of governor application involves control of the output shaft of the torque converter in addition to the usual function of engine speed control. The torque converter shaft speed is, of course, dependent upon the applied torque and the power input to the converter from the engine. It is apparent that certain types of converter installations require essentially constant speed at the power take-off shaft in order to provide ease of control of the equipment as load and power demand vary. A power shovel, for example, requires application of engine power at the exact moment that the dipper begins to load or as the digging gets harder; and power must be removed just as quickly when the bite is completed. A drag line must also have instantaneous control of power input as ground conditions vary.

A bulldozer also represents an installation where constant speed of the output shaft is very desirable since ground speed must not increase suddenly as the blade is raised, particularly if the blade is raised at the edge of an embankment. The Woodward SGT dual governor illustrated here provides a single unit control which makes the operator's job much easier by relieving him of the responsibility of matching input and output power. Not only is his job made easier but the operation is safer because the converter can never exceed its design speed, and a vehicle such as a crawler tractor equipped as a bulldozer will have its ground speed safely limited.



The new governor as mounted on a Cummins diesel. Independant control of engine and output shaft speeds is effected through a connection to the engine and to the torque converter. The connection to the torque converter can be seen as the flexible cable at bottom center of the circle.

Another feature provided is that of controlled power take-off speed for tractors using converter transmissions.

The principle involved in the SGT torque converter governor is that of independent control of engine and output shaft speeds through two separate hydraulic governor elements with ability of either unit to override the other in the direction to reduce power. Instead of the usual small hydraulic governor arrangement in which the engine governor pilot valve supplies the oil directly to a servo which controls the fuel pumps this oil is supplied to a secondary governor pilot valve which is controlled by a set of flyweights driven from the converter output through a flexible shaft. This secondary pilot valve then controls the flow to the servo if the engine governor is running below its set speed and the engine governor takes over if the converter governor runs below its set speed.

It will be seen that the engine governor speed setting serves as a power limit whereas the converter governor speed setting determines the speed at which the output shaft will run if there is enough power available and capable of being operated through a single control lever if desired, the governor becomes a complete power control. If it is desired to control power input to the converter to hold zero speed as in steel setting in which some power must be supplied to hold a load stationary without the use of brakes, it is only necessary to control the speed of the engine at a value at which full torque will produce the horsepower required to hold the load stationary. An increase in engine speed setting (or an increase in power available) will increase the load and a decrease in engine speed (or a decrease in power available) will lower it.

Control of vehicle, hoisting, swinging, or digging speeds is accomplished through control of converter governor speed setting. When adjustable control of both engine and converter speed is wanted, a single operating lever is usually used, with the first segment of travel adjusting engine speed setting and the second segment adjusting output shaft speed setting.

There have been a number of converter governor installations made on a wide variety of jobs, such as hoisting, excavation, coal stripping, ore digging, locomotive crane applications, log loading, and crawler tractors, and all have resulted in very favorable acceptance of this type of control.

Features of the MWM Mannheim Diesel

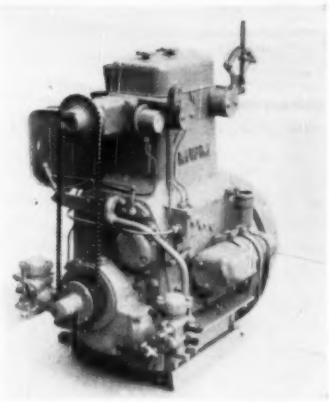
RESURGENCE of German industry is evidenced by the appearance of a line of German engines on the American scene. They are the product of one of the earliest diesel builders in Europe, the MWM Motoren-Werke Mannheim A. G. Carl Benz, whose name is on some of the early diesel patents was the founder of this organization that is currently building engines of from 4 to 1000 hp.

Particular emphasis in this country is placed on their model KD 415 engine built in 1 to 3-cyl. executions. Horsepower ratings are 12, 24 and 36 respectively at 1500 rpm. These are all 4-cycle units having the same bore and stroke. Simple and rugged construction is used throughout and the engines are adaptable for any type of application within their horsepower range.

All moving parts are completely enclosed thus presenting smooth lines and making the engine oil tight and easy to keep clean. The crankcase and cylinder block are integrally cast of a special alloy iron. The generous proportions of the crankcase permit space for mounting and enclosing the bulk of moving parts.

The rigid crankshaft is a high-grade steel drop forging having hardened crankpins. Drilled passages are provided for pressure lubrication. The shaft is mounted at both ends in roller bearings. These are comparatively insensitive to lack of oil and reduce friction to a minimum. Escape of oil is prevented at the flywheel end by a seal and at the other by a narrow bearing that also serves as the entry point of oil to the drilled passages. The anti-friction mounting plus counterbalancing insures smooth vibrationless operation.

Gearing from the flywheel end drives the camshaft and the lube oil pump. The latter is of the piston type in the 1- and 2-cyl. executions and of the gear type in the larger model. An edge type filter is incorporated ahead of the pump suction. The camshaft is also mounted in roller bearings and has cams for the operation of the valves and fuel pump and turns the governor as well. Bores in the crankcase structure directly above the cams serve as guides for the valve tappets. The push rods pass through pockets within the structure to the rocker arms mounted on the cylinder head.

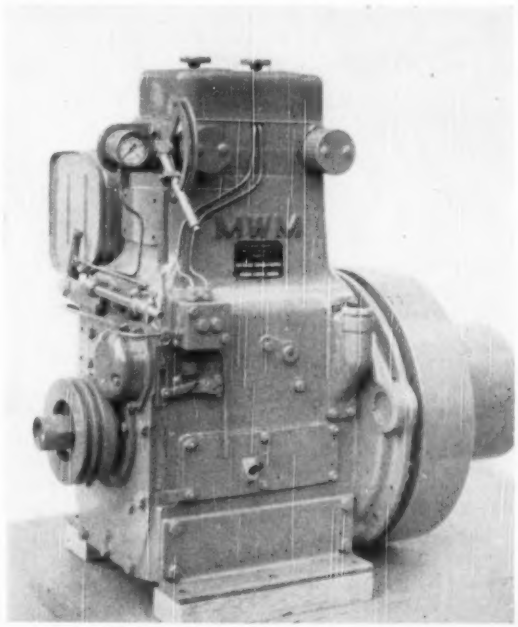


Cooling water passages are also provided in the block portion of the main casting. Centrifugally cast alloy iron liners of the wet type are used, the bores of which are chrome plated. The connecting rod assembly consists of a drop forging with a split type bearing lined with white metal in the big end and a bronze bushing in the eye for the hollow, hardened and ground piston pin. The pistons are made of a light metal and have three compression and two oil-control rings.

All of the parts described are contained within the structure of the main casting. On the exhaust side, large access doors are provided to permit pistons and rods to be removed without disturbing the cylinder head.

The cylinder head, regardless of the number of cylinders, is a single casting. A precombustion chamber is cast as a cavity in the head and the injection nozzle mounted so as to discharge into it. It also incorporates the valves and their attendant mechanism. Generous cooling water passages surround the areas of critical heat. A valve cover mounts over the rocker arm mechanism thus completely enclosing the engine.

The fuel system consists of a Deckel variable stroke injection pump with



(above and right) Two views of the KDW 415 Z two - cylinder MWM engine show arrangements available.

one plunger per cylinder. Plunger stroke and hence delivery is varied by cam action. The discharged fuel passes through the high pressure lines to the spring loaded, hydraulically operated injectors of German Bosch design. Fuel filtration is in three stages including a primary filter, one of the final type and an edge type unit in the injector.

Wide application of the engine is facilitated by the flexibility of engine arrangement. Both ends of the crankshaft extend from the crankcase. A variety of arrangements is possible at the flywheel end for different types of power take-off. The other end may be used to mount pulley sheaves for operation of fans, auxiliary pumps, etc.

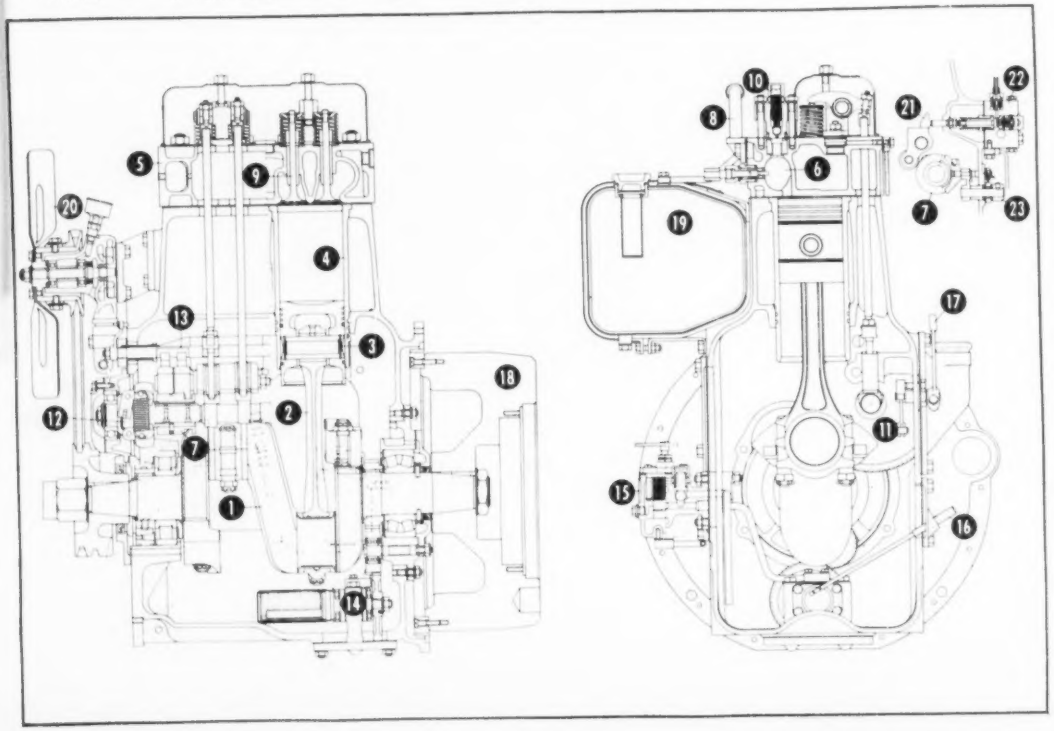
Starting also permits some flexibility. The engines are small enough to be hand started but arrangement is also made for electric starting if desired.

Various cooling arrangements are also possible. The engine can be adapted by selection of auxiliary items for either open or closed circulating systems or cooling on the thermo-siphon principle. In the closed systems, radiator and fan, evaporative coolers or heat exchangers can be used.

The design of this engine is well tried and proven. MWM has produced and distributed over 50,000 of these units representing almost 1,000,000 hp. in the last few years. Incidentally, they have designed an entirely new engine of smaller size with a range of 5 to 7.5 hp. at 1350 to 2000 rpm. This small engine is of the horizontal type and is expected to weigh approximately 300 lb. Its dimensions are: Length—27.6 in.; Width—21.5 in.; and Height—19.7 in. It is believed to have a field of application in units currently utilizing gasoline engines.

	TYPE		
	KDW 415 E 1 Cyl.	KDW 415 Z 2 Cyl.	KDW 415 D 3 Cyl.
Bore (approx.)	3-15/16"	3-15/16"	3-15/16"
Stroke (approx.)	5-29/32"	5-29/32"	5-29/32"
Cubic Capacity (cu. in.)	72	144	216
Maximum Torque (ft. lbs.)	43.4	68.8	130.2
Output Hp.	6-12	12-24	18-36
Speed rpm.	750/1500	750/1500	750/1500
Compression Ratio	17.3 to 1	17.3 to 1	17.3 to 1
Fuel Consumption Pound per Hp-hr.	0.43	0.43	0.43
Lubricating Oil Consumption Ounce per Hp-hr.	0.141-0.176	0.141-0.176	0.141-0.176
Approx. Net Weight Without Extra Fittings, Lb.	705	970	1124

6. Pre-Combustion Chamber
7. Fuel Cam Shaft
8. Water Outlet
10. Injection Valve
11. Cam Shaft
12. Governor
13. Stop Shaft
14. Oil Pump
15. Oil Filter
21. Injection Pump Lever
22. Injection Pump
23. Throttle



Trouble shooting on the
Sheppard Fuel Injection System
as applied to diesel tractors

*by R. L. Willetts**

SINCE THEIR appearance on the tractor market, the Sheppard diesel tractors have caused a lot of comment. To the mechanic familiar with the injection system commonly used on a number of other make tractors, the difference seems great. The Sheppard system, being inherently simple, is one that can readily be checked for such troubles as may arise by any competent mechanic without special equipment.

To give a brief description of the system, it is a variable stroke pump controlled by a mechanical fly-ball type governor. The injectors are of the open type using a spring-loaded check or nozzle valve to prevent the pressurized gases of the cylinder from entering the nozzle and lines. The stroke of the plunger is varied by changing the lift of the cams that are radially mounted in and revolving with the camshaft.

These cams, one per cylinder, are retracted or extended by endwise movement of an inner shaft concentric and rotating with the outer or camshaft. Each cam has a pin through it, each end of which rides in a bushing. These bushings, in turn, rest in inclined slots cut in the inner shaft. Thus, longitudinal movement of this shaft causes the cams, retained in their recesses in the outer shaft, to be moved at right angles to the axis of rotation through the action of the inclined planes.

When extended beyond the outer diameter of the camshaft, the cams strike the cup-shaped fuel pump cam followers on which the spring loaded delivery plungers rest. Both cam noses and followers are contour ground for best injection characteristics.

Each individual pump is mounted above its respective cam and follower with an adjusting plate between the camshaft housing and the fuel pump cylinder. This adjusting plate or equalizing head, when turned, has the effect of raising or lowering the cylinder through screw action to alter the maximum effective stroke. Rotation is obtained by two adjusting screws; the front screw turned inward will increase the maximum effective stroke while the same action on the rear screw will decrease it. Tightening both screws locks the adjustment.

The fuel pump cylinder assembly consists of a bronze cylinder containing the inlet port and discharge port with its discharge valve. The piston fits tightly in the cylinder bore, the lower end of the piston is threaded and fitted with a special nut having its under face ground for seating in the cam follower. The maximum effective stroke can also be altered at this point by threading the nut on or off to change the overall piston length. This nut is locked by another wider nut that also serves as a spring seat.

Attached to the top of the cylinder is a second discharge valve assembly and a tube fitting that are considered part of the injector assembly. Other components are the tubing and the injector assembly itself. The latter consists of a tube fitting body, which screws into the injector nozzle, the nozzle and the nozzle valve. The combustion chamber into which the fuel is injected is a major factor contributing toward the excellent operating characteristics obtained. However, no trouble is experienced with the chamber so further mention will be omitted.

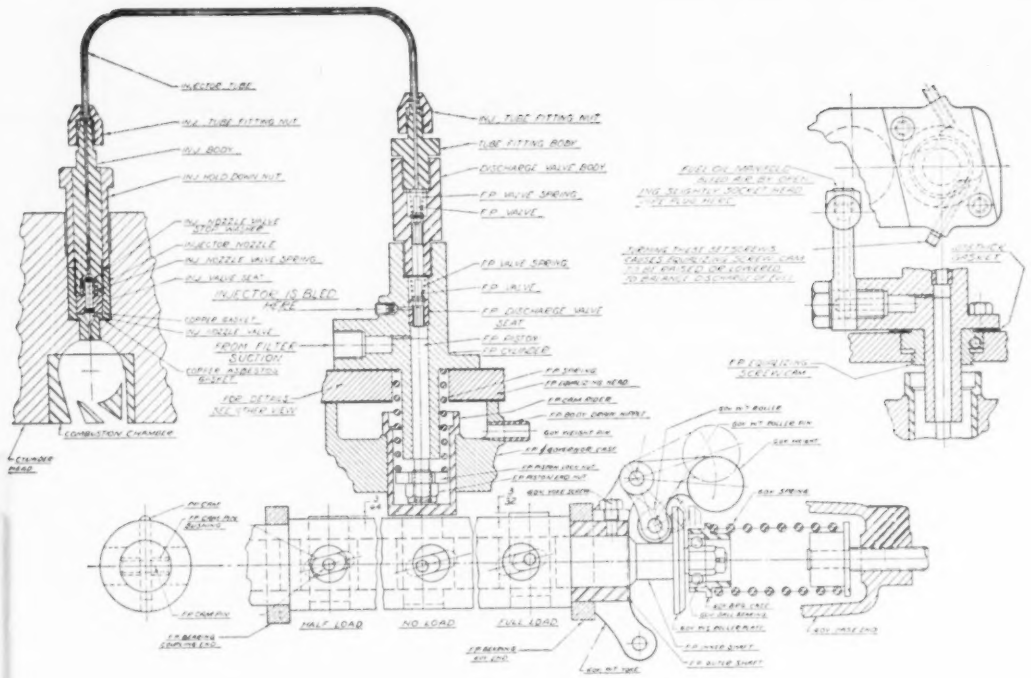
Before entering into a discussion of the methods for checking the injection system, it should be stated that the procedures are predicated on the basis that all mechanical details of the engine particularly the valves are in good condition.

The preliminary steps are so simple as to seem ridiculous but how often they are overlooked. First, check the fuel supply. Is the line clogged? Is the filter clean? Is there water from condensation in the filter? Is the tank full and is the valve turned on? Last but not least, is the tank full of diesel fuel or gasoline? It will only take a few minutes to make sure that these things are all right.

Now, assume that the trouble symptoms are loss of power and missing. The exhaust may show puffs of white smoke and sound very irregular. The white smoke is an indication of air in the system. The system should be bled starting with the filter, next, the manifold connecting the pump cylinders and then the cylinders themselves. Set screws are provided for bleeding the manifold and there is a small bleeder screw on the side of each cylinder. The latter should be loosened about a turn with caution exercised. A small ball check is held in place by the screw and unless great care is taken in the event of removal of the screw, the ball check may be lost. When bleeding, remember that fuel with bubbles is fuel with air. Continue bleeding until a solid flow appears.

Should loss of power accompanied by black smoke be encountered, it is time to check further into the injection system. The best method is to use exhaust temperature indicators and ascertain the individual cylinder temperatures under load. With no smoke and exhaust temperatures ranging from 800 to 900 deg F., full power is being received. However, if power is being lost as soon as the maximum

*Service Manager, R. H. Sheppard Company



load is applied, one or more cylinders will show a low temperature and further investigation of the particular cylinders is necessary.

If temperature indicators are not available, fuel delivery may be roughly checked by feeling the pulsations in the injection lines. Care must be used here to, first, check at $\frac{3}{4}$ to full load and, secondly, to remember that this is a low pressure system and that pulsation magnitude varies with the number of bends in the tubes.

Having found the affected cylinder, the injector nozzle should be checked to ascertain if the valve is leaking. Seldom if ever, will the orifice need cleaning and then only during a major overhaul. The orifice diameter is 0.042 in. and the size is not particularly critical. To determine if the valve is leaky, disconnect the injector line at the injector and turn the engine over. It can be readily seen that if fuel and/or gases squirts into the air, the valve is leaking and needs replacement. Using two wrenches, the injector nozzle is removed from the body, the old assembly removed, and a new one dropped into place. The injector is then replaced after renewing the injector-to-cylinder head copper-asbestos gasket.

If the nozzle valve does not need replacement, the throttle should be placed in the full speed position and again the engine should be turned over. This time, fuel discharge from the injection line should be watched. The flow should be in rapid, well defined spurts. If not, the discharge valves in the fuel pump cylinder and the injection line fitting should be checked for cleanliness. Should injection still be poor after washing, the valves may be very lightly lapped on their seats, using a small amount of jeweler's rouge for an abrasive.

In the event that no fuel was delivered, a sticky or stuck fuel pump piston is indicated. This can be definitely determined by removal of the fuel pump manifold and, with the help of a light, looking through the inlet port to see if the piston is opening and closing it. When a piston sticks it must do so in the upper position, thus keeping the port covered.

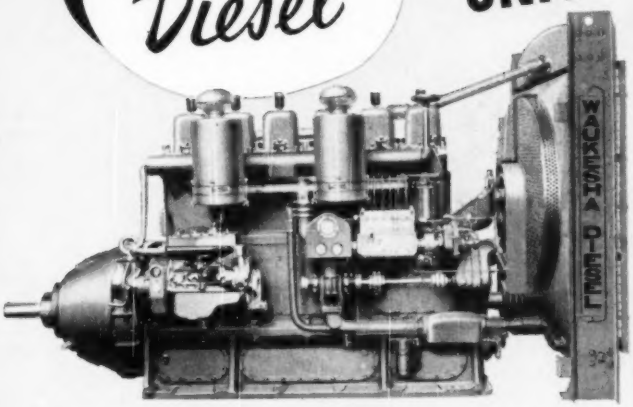
Freeing of the piston can be accomplished in different manners depending upon the cause of sticking. Sometimes unstable fuels that have been stored for long periods will tend to form gums that will stick the plungers. Removal from the engine and washing with solvents will correct the trouble but frequently it can be done right in place. The application of heat, sometimes as little as that supplied by hand contact, will free it. Another method is to loosen the two cylinder hold-down screws a half turn while the engine is running.

Sticking caused by dirt requires the removal of cylinder and piston from the engine. Careful washing with clean diesel fuel or a solvent will usually restore the pump to operation. There is, however, the possibility that the dirt will have damaged the piston and cylinder beyond repair making a replacement necessary.

The procedures mentioned are the only ones with which the average mechanic need be familiar. Troubles other than these, due to the construction of the remainder of the pump, will be readily recognized and corrected by him or will be of such a nature as to be beyond his scope.

WAUKESHA

6-LRDU Diesel POWER UNIT



BULLETIN No. 1480

WAUKESHA MOTOR COMPANY • WAUKESHA, WIS.

Eastern Sales Office: Eight W. 40th St., New York 18, N. Y.
Mid-Continent Office: 703 S. Wheeling St., Tulsa 4, Okla.
Pacific Coast Office: 4927 Pacific Blvd., Los Angeles 11, Calif.

This one is for You

It's another new Diesel power unit—Waukesha's latest and largest, the 6-LRDU—and here's your copy of Bulletin 1480 to tell you all about it . . .

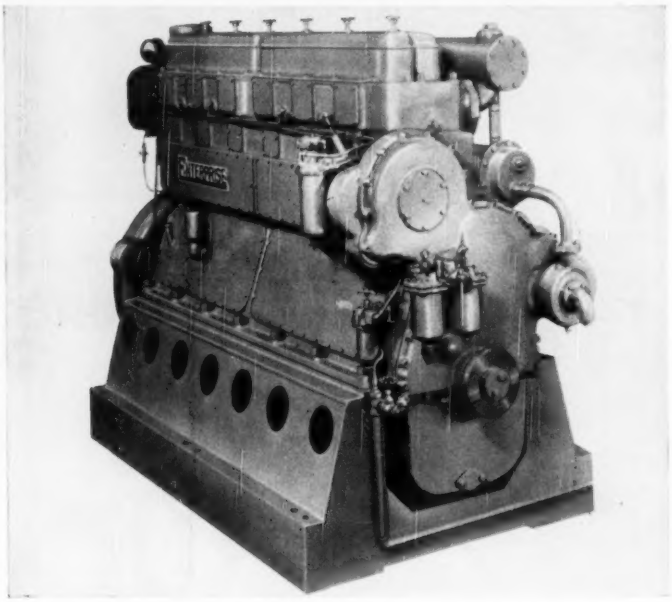
This heavy-duty unit has a vertical, six-cylinder, four-cycle, solid injection, compression ignition Diesel engine—8½-in. bore x 8½-in. stroke, 2894 cu. in. displacement. Most unique is the patented combustion chamber, which burns all standard "high-speed Diesel fuels" of 45 cetane and above. Within its rated load and speed range combustion is smooth and quiet. No shudder, no smoke, no soot.

The massive graphitic steel crankshaft has seven 5½-in. main bearings. Cylinder block is a single casting; wet sleeve cylinders are hardened to 400 Brinell. American Bosch injection! The large 4-cylinder cranking engine with its 20-30 hp. output, gives easy, speedy starting even in coldest weather. Find out about all this Diesel's special characteristics and its high fuel economy and low maintenance.

Ask for Bulletin No. 1480

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
NEW YORK • TULSA • LOS ANGELES

New Products



New Enterprise Engines

A new series of smaller, heavy-duty stationary diesel engines has been announced by Enterprise Engine & Machinery Co. They are designated as the Enterprise M-series Diesels. Built in 3, 4 and 6 cylinder models with 8 in. bore and 10 in. stroke, these engines range from 63 to 240 hp. at medium speeds of 450 to 750 rpm. All models are of 4-cycle design.

The M-series extends the lower hp. range limit of the Enterprise diesel line from its previous range of 130 to 1755 hp. and provides high economies of installation and operation for a much broader field of stationery and portable industrial applications.

The result of more than four years research, engineering, plant and field testing, the M-series embodies all of the more advanced design, metallurgical and operational developments in the diesel engine field. These are compact, rugged power plants, designed for continuous, heavy-duty service with minimum maintenance. Small space requirements contribute to the outstanding versatility of these medium speed, high capacity engines, while flexibility of attachment to many types of driven equipment and auxiliaries is made possible through simplicity of basic design.

Taper Attachment

A new taper attachment that can be mounted on all makes of engine and tool room lathes in a few minutes has been introduced by the Master-Taper Company. The firm says that this new attachment makes taper turning, boring and threading as simple as any straight-line tool operation.

Known as the Master-Taper Attachment, this new item is said to be suitable for lathes having a swing up to 36 in. and to cut a taper of 20 deg. or 4 in. per ft. and 12 in. longitudinally at one setting. The sliding fixture has a long bearing surface with gibs to compensate for continuous usage. The swivel bar has V-ways with the ends graduated — one in degrees and the other in inches per foot.

Arc Welding Process

A new welding process employs welding current densities on 5/64 in. electrode wire which melt the electrode at speeds comparable to using 10,000 amperes on a standard 5/16 in. diameter coated hand electrode. The new *Hidensity* process can be used with any standard Lincoln Electric SAE 600 or SAE 900 welding generator or an SAE 600 gasoline engine-driven generator.

The new process uses either a 3/32 in. or a 5/64 in. diameter electrode wire. Welding currents up to 600 amperes are used with these wires which, on the small cross sectional area of the wire, produces extremely high current densities. These high densities create a deeply penetrating arc which in turn allows the use of high welding speeds. This also means that in general little or no edge preparation of joints is required, and therefore less weld metal is used in completely fusing the joint.

Wheel Truing Machine

A new wheel truing machine designed and developed after four years' work by the Standard Railway Equipment Manufacturing Company was announced recently. The machine is being manufactured by Continental Foundry & Machine Co.

The new machine permits the reconditioning of locomotive and car wheels without taking the wheels off the unit. The machine rests in a specially-built pit below the locomotive and "grinds" one set of wheels at a time.

It is said that the machine will restore the original contour to all wheels of a diesel locomotive in eight hours. This represents a substantial saving in time since it normally takes about 48 hours to remove the wheels of a locomotive, turn them in a lathe and replace them.

Aeromaster Fan

Development of a high efficiency industrial axial fan employing aerodynamic design principles and aircraft production techniques has been announced by Sid Fedan, Manager of the Aeromatic Propeller Department of Koppers Company, Inc.

Manufactured in the Baltimore Propeller shops the new *Aeromaster* fan is applicable to engine jacket water coolers for natural gas, gasoline, or diesel engines; vertical air discharge condensing units; various oil field and power utility air coolers and water coolers; and large air conditioning systems.

Drilling and Tapping Unit

A high speed, precision automatic drilling and tapping unit that utilizes either hydraulic or pneumatic power, offers one stroke or continuous cycling, has a rotating and reciprocating spindle and permits speeds up to 20,000 rpm. has just been introduced by HyPneuMat Inc.

Named the *HyPneuMat*, the unit has a drilling and tapping capacity of $\frac{3}{8}$ in. in steel, and a $\frac{1}{8}$ to $3\frac{1}{2}$ in. stroke. Its features, in addition to automatic cycling, are said to include infinite adjustable feed, adjustable stroke for both directions, variable spindle speed, uniform smooth power, ease of installation, automatic, hand or foot control, dwell action adjustable from 0 to 120 seconds, chip cleaning action, etc.

Complete versatility is claimed for the unit making it practical for light, precision and heavy duty work. At 100 psi. air or hydraulic pressure the unit is said to deliver more than 700 lbs. tool point thrust on the work.

Aluminum-Steel Gears

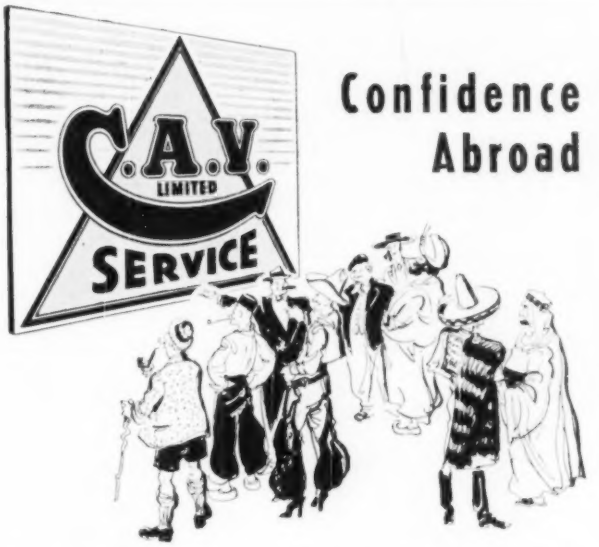
A new gear made of aluminum, with a bonded-in steel hub, has been developed by the Al-Fin Division of the Fairchild Engine and Airplane Corporation, according to M. V. Little, Acting General Manager of the Division. Said to be lighter, and stronger than molded resin and fiber gears, the Al-Fin bonded gear can stand heavier loads.

Perfected after two years of research and testing, the gears, which are hobbed and shaved, are as quiet in operation as the composition type. Made of aluminum alloy, bonded to steel with a molecular process originally developed by Al-Fin, the gears have a tensile strength of about 15,000 psi. With steel hubs there is no danger of the aluminum gear conforming to the shaft. The gear has withstood shear tests of the bond up to 98,000 pounds.

Rotary-Fixture Bender

A new rotary-fixture machine for bending irregular shapes or true radii in tubing, bars, extrusions or roll-formed sections up to 8-in. wide is announced by Pines Engineering Company.

The new bender employs a horizontal stationary pressure pad of either steel or bronze construction which is air operated against a rotating-type die head. The die head is mounted on a heavy vertical spindle which is gear

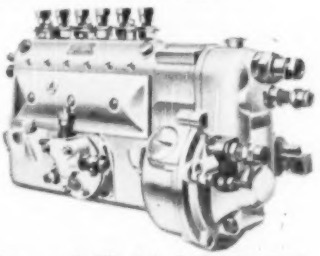


Confidence Abroad

Transport operators all over the world have learnt to trust this sign.

In any language the letters on the C.A.V. sign stand for first-rate service facilities, maintained by highly-trained craftsmen, using special precision equipment.

Wherever vehicles fitted with C.A.V. Fuel Injection Equipment are exported — whether to Trondheim, Santiago, Hong-Kong or Sydney — there's a service agent or depot to give it the specialist attention needed for such high-precision equipment.



C.A.V.

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Service Depots throughout the World

C.A.V. DIVISION OF LUCAS ELECTRICAL SERVICES INC., NEW YORK 19, N.Y. Sales Office: 14820 DETROIT AVE., CLEVELAND 7, OHIO

174-344B

driven by 7½ hp. motor. A variable speed motor provides die head speed variations.

Limit switches and adjustable dogs control the degree of rotation of the die head during the working cycle and are easy to set to provide the required angle of bends. Convenient electrical push buttons permit starting, stopping, or reversing the cycle at any point.

A lever-operated cam work clamp applies pressure for holding the stock. The adjustable slide mounting of the air cylinder provides the capacity for handling bends up to 7 feet in diameter. Change-overs in tooling set-up from one part to another can be easily made by one man in 30 minutes.

Handy Puller

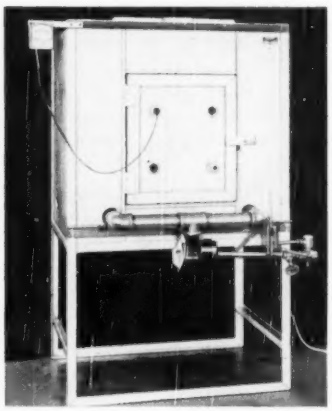
A new, larger capacity Mighty Midget Puller has been announced by the Coffing Hoist Company. The puller weighs 9½ pounds, takes up less than a foot of space, yet is said to handle a full 1000 lb. load on any lifting, stretching or pulling job.

This combination of easy portability and big puller power is said to make it especially useful both as a production and a general shop maintenance tool for lifting heavy dies and castings, and holding them in place for welding, installing equipment, loading and unloading trucks, plus many other odd lifting and pulling jobs.

The handle serves a double purpose. It may be used as a straight lever when loads are especially heavy, or where lack of headroom allows only partial strokes; or the lower section may be locked at right angles to the upper section, forming a crank for high-speed lifting or pulling.

Precision Furnace

A. D. Alpine, Inc. is introducing a new precision furnace for the heat-treating of metals. This Alpine Precision Heat-Treating Furnace is available in capacities ranging from 1.8 cubic feet to 20 cubic feet and has a range of from 0 to 2500 deg. F. The furnaces are equipped with porcelain protected thermocouples and direct-reading pyrometers with calibrated energy input and atmosphere proportioning.



Economy of operation is effected by means of a patented forced draft type of burner which will operate successfully on natural, manufactured or liquid petroleum gases. Safety is insured by means of a solenoid valve which cuts off the fuel in the event that an electrical failure stops the blower, then automatically relights and resets the fuel input when the electrical failure has been corrected.

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Machined
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✓ SPECIALIZATION
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Specialization is the key to precision, and for twenty-two years Carey has specialized in the *Precision Machining* of connecting rods. Some of America's leading manufacturers of Diesel Engines and Compressors use this service. Carey facilities include 40,000 square feet of modern plant space, skilled operators and highly specialized equipment, resulting in low unit costs for Carey customers. It pays you to find out how you can benefit from Carey's specialization, precision, experience.
Send your blueprints for quotation — no obligation.
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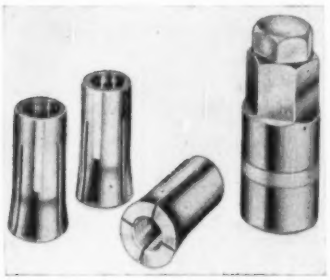
Stud Pullers

Snap-on Tools Corporation has recently announced the addition of two series of threaded collet type stud removers and inserters. The smaller size unit has 14 different collets available to handle studs from $\frac{1}{4}$ in. to $\frac{5}{8}$ in. in diameter in both fine and coarse thread sizes. The larger model has 6 collets available for $\frac{3}{4}$ in. to 1 in. diameter studs in fine and coarse thread sizes.



Operation is simple . . . the correct thread size collet to fit the thread of the stud is inserted in the housing, and the whole unit is then threaded over the stud. Turning the bolt on top draws the slotted tapered collet up into the housing compressing it and locking it onto the stud threads with a slip-proof grip. The collets are all keyed to prevent them from turning inside the housing. Once the tool is locked onto the stud the whole assembly becomes a rigid unit that can be turned with a socket, *Boxocket*, or open end wrench. As the collets fit the threads the pull is directly from the threads only, the studs are not damaged in any way. They can be reset and reused again if desired.

Drill Press

The South Bend Lathe Works has announced production of a new, low priced drill press in both bench and floor models. Known as "Economy Model", this 14 in. drill press is ruggedly constructed for continuous industrial service. The net weight of the bench model, for example, is 124 lbs., less motor and chuck.

General specifications are: capacity to drill to center of 14-$\frac{3}{4}$ in. circle, maximum drill size $\frac{1}{2}$ in. in steel, spindle run-out 0.005 in., spindle

ANNOUNCING

Leece-Neville

Complete Cranking and Lighting Systems for

DIESELS

Generators—14 volt, 40 ampere, low cut-in, and 50 ampere. Standard swivel mounting, as shown, or strap mounting.

14 & 28 VOLT SYSTEMS

Voltage Regulator of rugged construction for heavy duty service.

Magnetic Switches for 14-28 volt series-parallel systems and standard 14 volt systems.

Series-Parallel Magnetic Switches for 14-28 volt series parallel systems. Designed for use with generating systems up to 175 amps.

Cranking Motors for 14 volt and 14-28 volt series-parallel systems.

Genuine Leece-Neville Costs No More

Owners of diesel equipment can now have a Leece-Neville high-quality electrical system without paying a premium price. With it they get unequalled freedom from maintenance and breakdown expense.

Manufacturers who make Leece-Neville standard equipment find it pays off in sales.

For complete specifications, write Dept. 94, The Leece-Neville Company, Cleveland 14, Ohio

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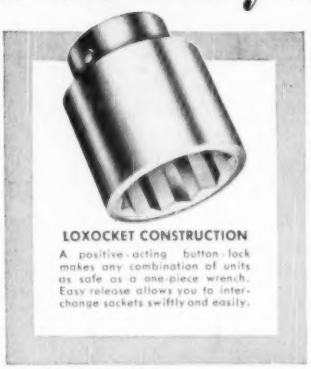
Compact Power! Rugged Strength! Tremendous Leverage!

Snap-on*

twenty-one piece • 1" Square Drive

Extra Heavy Duty Socket Set


LOXOCKET CONSTRUCTION
A positive-acting button-lock makes any combination of units as safe as a one-piece wrench. Easy release allows you to interchange sockets swiftly and easily.

THESE tools give you the extra power and leverage to break loose big rusted-on nuts and bolts, or to pull them up to the tightest degree. It is a husky set that speeds the heaviest nut-turning work with great safety because of the famous Loxocket design.

No. 521-EHD-B Set includes 17 Hexagon Loxockets from 1-7/16" to 3-1/8". The handle equipment consists of a Ratchet Head, Sliding Bar and two Extension Bars, 8" and 16" long.

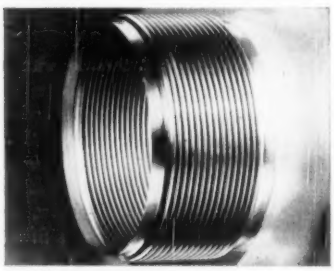
*T M Reg U S Pat Off

SNAP-ON TOOLS CORPORATION
8034-1 28TH AVENUE
KENOSHA, WISCONSIN

square to table within 0.0075 in. in 5 in. Table surfaces and the base surface of the bench model are precision ground and slotted. The table also has a ¾ in. thick edge rib all around for the clamping of work. A vertical mounting 1/3 hp. or ½ hp., 1725 rpm. motor may be used to power these drill presses and will give the operator a choice of four spindle speeds ranging from 740 to 4070 rpm. Additional speeds from 380 to 7770 can be obtained by use of a multi-speed attachment provided the drill press is equipped with a capacitor type motor.

Stainless Steel Bellows

Chicago Metal Hose stainless steel bellows are now available in a complete range of sizes. They are said to be ideally suited where problems of pressure, high and low temperatures, and corrosion are factors. They are especially suited for applications of control devices and instrumentation, such as regulators, valves, steam traps, shaft seals, expansion connections and flexible connector for misalignment.



CMH stainless steel bellows are manufactured in single and multiple construction and various lengths, dependent upon application requirements.

Bellows or bellow assemblies with standard fittings or fittings to customer's specifications can be supplied. Fitting attachment may be attached by electrical circular seam welding to assure leakproof uni-metal assemblies.

Zeolite Water Softener

A small zeolite water softener for apartment houses, hospitals, laundries, small boiler and industrial plants

where the requirements may be under 100 gal. per minute is announced by the Cochrane Corporation.

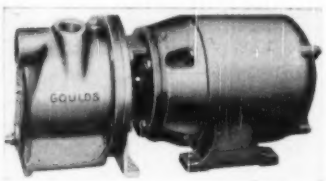
Designed for low initial cost, simplicity of operation and for low cost of chemicals used, the Cochrane Junior Industrial Zeolite Softener is supplied in two groups and in single and double units, to meet practically all requirements. Group I comes in 12, 18, 24, and 30 in. tank diameter, and Group II in 36, 42, and 48 in. tank diameter.

The single unit is recommended if a storage tank for softened water is available which can be called upon while the softener is being backwashed and regenerated (about 45 minutes). A single unit may also be used if the supply of softened water can be interrupted during backwash and regeneration, or if raw water may be used temporarily during this period.

If this is not possible and a continuous supply of softened water is mandatory, the double unit softener is recommended.

Self-Priming Pump

Goulds Pumps, Inc. announced recently an unusual new line of self-priming centrifugal pumps. These new pumps are said to give unique advantages in self-priming applications — for example, all valves are eliminated by the unusual design.



Other advantages listed by the firm are:

Positive self-priming, no large and bulky priming reservoir, no recirculation of water during pumping stage, and efficiencies comparable to standard centrigual pumps.

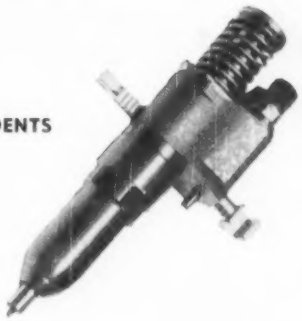
Patents are pending on the new design. Made in sizes from $\frac{1}{4}$ to 5 hp., open and closed impellers. Capacities to 120 gpm. and heads to 135 feet depending on capacity. Suction lifts up to 25 feet.

Attention:

MAINTENANCE SUPERINTENDENTS

AND OWNERS OF DIESEL

POWERED EQUIPMENT



HANCOCK

RECONDITIONED UNIT

INJECTORS FOR

GM 71 AND 567

ENGINES ARE

AVAILABLE FROM OUR

STOCK ON AN EXCHANGE

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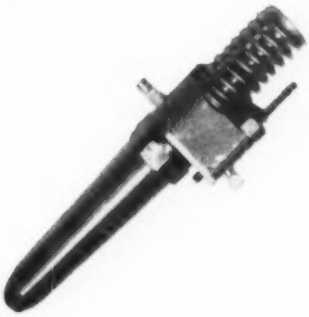

Hancock Service Gives You:

- √ One day delivery from our stock.
- √ The service of a modern injector laboratory completely tooled with the latest grinding, lapping and gaging equipment to handle all necessary work.
- √ A flat price for injector exchange regardless of condition of the plunger and bushing.
- √ A completely rebuilt unit injector that has been thoroughly tested after an actual run-in test.
- √ Any output of 71 engine injector available — 60 mm, 70 mm, 80 mm and 90 mm.
- √ An unconditional guarantee of satisfaction.

We will buy used General Motors and Caterpillar injection equipment.

Dealers write for our attractive proposition

Diesel Equipment Division

HANCOCK MACHINE COMPANY, INC.

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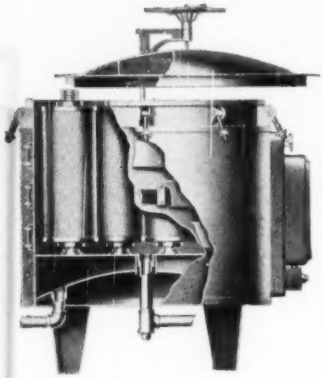
Less time for a change!

HOFFMAN Cartridge Filters



Simplify Cartridge Replacement with Exclusive Cover-Lifting Device

Along with efficient filtering at high flow rates, Hoffman Cartridge Filters provide maximum service convenience. Exclusive cover-lifting device speeds up cartridge change — either the 7 x 18 size, for Navy throw-away cartridges, or the 11 x 18, for repackable or throw-away types, offer this feature. Swing bolts fasten the cover — an additional advantage for cartridge changes.

FOR LUBRICATING, FUEL OR INDUSTRIAL OILS

Two sizes: I-718 for 7 x 18 Navy-size throw-away cartridges in multiples of 1, 2, 4, 7, 9, 14, and 18 cartridges. I-1118 series, for either repackable or throw-away cartridges, in multiples of 1, 2, 3, 4, 6, and 8 cartridges.

Write for bulletins A-703 and A-649 respectively.

Complete Recovery of Used Oil

—The HOFFMAN OIL CONDITIONER

Removes insolubles, as well as solubles, to cut new oil costs. Unit consists of Hoffman Vaporizer (to remove oil, gas, moisture and fuel dilution) . . . Cartridge Filter to remove solubles. Mounted on a common base . . . only 2 moving parts . . . no steam or water connections.

Capacities of 50 to 600 g.p.h.

Write for Bulletin A-667 and A-668

FILTRATION DIVISION

U.S. HOFFMAN MACHINERY CORPORATION

214 LAMSON STREET, SYRACUSE 6, N. Y.

CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO., LTD., NEWMARKET, ONT.

Temperature Controller

A temperature controller with automatic protection from thermocouple burn-out has recently been introduced by Assembly Products, Inc. Known as the *Simplytrol*, the instrument is a thermocouple millivoltmeter type controller with control action obtained by direct contact in the meter.

There are no vacuum tubes in the new instrument and no motors are used. The indicating, contact meter-relay operates directly into the load switch. Electric oil or gas fired equipment may be controlled.

Eight standard ranges cover temperatures from —75 to +3000 deg. F. All dials show both Centigrade and Fahrenheit readings and standard calibrations are for use with Iron-Constantan, Chromel-Alumel and Platinum type thermocouples. Models with automatic thermocouple break protection shut off the power immediately in case of thermocouple failure.

New Literature

Silencer Booklet

A new booklet which describes the complete line of mufflers of the Kittell Muffler Division of the Marquardt Aircraft Co. has recently been released by the firm. Included in the booklet are sections on design, specification tables, and a brief description of the various types and models of mufflers manufactured by the concern. A short table is also incorporated in the publication which enables the reader to tell at a glance what type of muffler or spark arrestor he should use for his particular problem. The firm makes equipment for industrial, marine or mobile application.

Hose Portfolio

The Weatherhead Company has just completed the printing of a three pocket portfolio containing the latest catalogs covering their line of industrial hose and hose ends and tube fittings.

Catalog H-1451 lists The Weatherhead Company's latest development of Reusable Steel Hose Ends and Industrial Hose for all hydraulic purposes, fuel and oil lines for diesel engines or for any other flexible hose requirements. This material offers a range of working pressures up to 5,000 psi. with burst pressures ranging up to 16,500 psi.

Catalog No. E-1457 is the latest edition of the patented Weatherhead Ermeto Steel and Stainless Steel Fittings. The Weatherhead Ermeto fitting requires no flaring, no threading, no welding, and no soldering—consists of only three parts and is easily assembled. It has been used for special instrument work at pressures up to 40,000 psi. and in the smaller sizes has been tested at hydrostatic pressure of 65,000 psi. without failure. The Ermeto fitting provides an ideal method for coupling diesel fuel injection lines without upsetting the end of the tubing and gives longer life to injection tubes under severe vibration conditions.

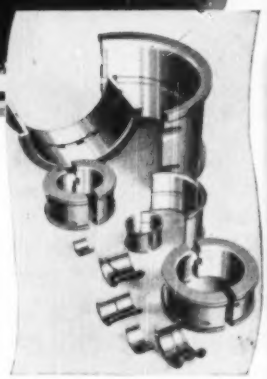
Catalog No. F-1456 shows a complete line of brass Inverted, S.A.E., Compression, Threaded Sleeve type and Pipe fittings. These fittings are made from extruded brass rod permitting large flat wrench surfaces on all elbows and tees. Furthermore, the use of extruded rod eliminates all danger of porosity, gives greater strength to fittings than castings and are lighter in weight, with equal strength, than forgings.

Oakite Booklet

An interesting account of materials and procedures designed to simplify the removal of oil base and synthetic paints, enamels and similar finishes from metal surfaces is provided in an illustrated, 14-page booklet just published by Oakite Products, Inc.

The booklet discusses specific paint-

Uniformity and precision of JOHNSON BEARINGS assure LOW COST INSTALLATION



WORKMEN who slip bearings into place know that Johnson Bearings never cause delays. Executives who scan assembly costs realize the real economy of such parts. This precision and uniformity is not a "happenstance" at Johnson Bronze; highly trained and skilled men produce these bearings to exacting specifications. This is another phase of the Johnson Standard of quality.

Johnson manufactures a complete line of bearings for Diesels . . . main . . . con-rod . . . cam shaft . . . piston pin, etc.

You will find Johnson engineers willing to help you decide which type bearing is best suited and to design it to the application. Write, wire or call for an appointment today!

Johnson Bronze

SLEEVE BEARING HEADQUARTERS

470 SOUTH MILL STREET • NEW CASTLE, PA.

from surfaces. These are: (1) the hot flow-on method, where surfaces are flooded with hot solutions of stripping compound to remove paint from large areas or parts too big for immersion stripping; (2) the cold-spray method, where pressurized cold solutions are employed to strip paint from large parts when equipment or facilities are limited; (3) the steam gun method, where paint is blasted off surfaces by the rapid, combined action of steam and stripping compound; and (4) the tank immersion method, for effective stripping of rejected parts in mass production operations to prepare them for resurfacing.

Also discussed briefly in the booklet are specialized materials for surface preparation of parts before repainting to promote improved paint adhesion, and materials for efficient anti-rust protection of stripped rejects awaiting repainting.

Tractor Folders

Performance-boosting and cost-cutting features of International crawler tractors are graphically presented in two new two-page mailers issued by International Harvester Company.

A read-at-a-glance explanation of the simple, direct transmission-to-track power train of the typical International, is offered in Forum A-420-MM: "Is Your Horsepower Going to the Track?".

Exclusive three-point track suspension, for positive alignment and long track service life, is similarly displayed in the folder, "How Long is Your Tractor's Life Line?". Sketches illustrate the function of the front stabilizer, used only in Internationals, in preventing misalignment and minimizing leverage loads. Ask for Forum A-419-MM.

Binks Bulletin

Binks Manufacturing Company has recently announced the publication of Bulletin 41, "Binks Type 'D' Evaporative Heat Exchange Coils". These coils are utilized singly or in multiples to provide a "closed-type" cooling system for numerous commercial applications, handling a variety of liquids. They are popular for cooling diesel and gasoline engine jacket water and similar applications.

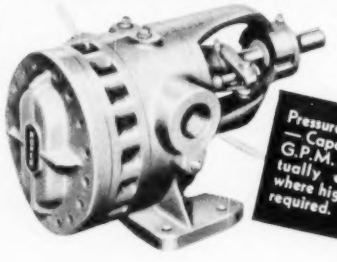
The liquid to be cooled is circulated through the heat exchanger in a closed circuit. The heat exchange coils are cooled by the showering action of raw water sprayed over the tube surfaces. The tubes in Binks coils are staggered for maximum surface exposure.

Type "D" coils are available by themselves or complete with a Binks natural or mechanical draft tower. Bulletin 41 gives complete data including dimensions, total effective surface, and weights for 17 coil sizes. Drawings and photographs illustrate the construction and use of the Type "D" coils.

Carbon Brush Bulletins

The first of a new series of bulletins dealing with carbon brushes for motors and generators in diesel-electric locomotives is announced by

WHEN THE HIGH PRESSURE IS ON...
RELY ON ROPER SERIES H PUMPS



Pumps built especially to develop pressures up to 1000 p.s.i. High volumetric efficiency provided by equal size spur gears operating in axial hydraulic balance . . . roller bearings and bronze wear plates reduce friction under heavy load conditions . . . splined drive shaft absorbs thrust loads. Most models can be direct connected, chain, belt, or gear driven. Specify Roper for *your* high pressure job.

Geo. D. Roper Corp.
169 Blackhawk Park Ave.
ROCKFORD, ILLINOIS

ROPER Rotary Pumps

NEW Sheppard DIESEL INDUSTRIAL TRACTORS

Sheppard Diesels, with their rugged, heavy-duty construction, are ideal for use with a hydraulic front end loader.

Four models
. . . 2 power sizes

Wherever quantities of material are moved by loader, blade or trailer, a Sheppard Diesel's 75% fuel cost savings can mean the difference between profit or loss on the operation. A Sheppard Diesel's extra lugging power is especially desirable when heavy loads must be moved up steep inclines or over soft, heavy footing. Arc welders, compressors, pumps and other similar equipment can be built integral with a Sheppard to provide a compact, self-propelled unit.

Cut Fuel Costs ON MATERIAL HANDLING Over 75%

Mail today for full information
SHEPPARD DIESELS • HANOVER, PA.
I am interested in a Sheppard Diesel Tractor for _____
Name _____
Address _____

DEALERS: Write for complete details on the profitable Sheppard Diesel franchise plan.

DIESEL'S THE POWER . . . SHEPPARD'S THE DIESEL

National Carbon Division of Union Carbide and Carbon Corporation.

The first bulletin explains the functions and physical properties of carbon brushes and the three primary requirements of a brush discussed under the headings: Conduction of Load Current, Sliding Contact and Commutation. Slip ring brushes and metal-graphite brushes are also discussed.

The series of bulletins has been planned as a service to those engaged in the operation and maintenance of diesel-electric locomotive equipment. They contain discussions of practical subjects pertaining to brushes and commutation to aid in solving some of the numerous problems associated with brush application. Some of the material has been published previously but in these bulletins emphasis is given to topics specifically related to the electric equipment used on diesel-electric locomotives.

Nickel Alloy Bulletins

Two new technical bulletins on the properties of high nickel alloys have been issued by The International Nickel Company, Inc. Both are twenty-four pages in length and contain charts, tables on compositions and properties, working instructions, and other information of a technical nature.

While each of the bulletins represents, to some extent, revisions of earlier bulletins on the same subjects, the revisions have been so complete and the new data contained so extensive that they are essentially new presentations.

Technical Bulletin T-7, one of the two, is entitled, "Engineering Properties of Inconel". In addition to information on Inconel, it contains material on Inconel "X", one of the newer age-hardenable Inco nickel alloys. The second publication is Technical Bulletin T-9 and deals with the engineering properties of "K" Monel and "KR" Monel.

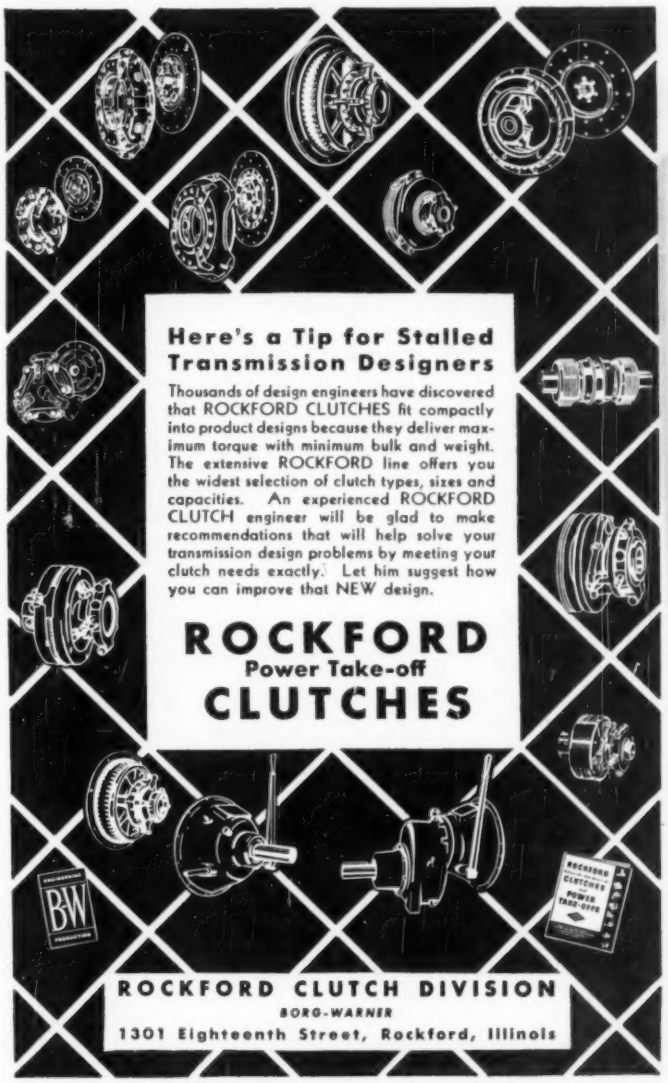
Bearing Booklet

The Anti-Friction Bearing Distributors' Association announces publication of a 20-page booklet titled "Installation, Maintenance, Removal of Anti-Friction Bearings". This booklet is probably the most comprehensive on the subject of bearing care to date. It has been compiled and printed by the Association as a service to plant supervisors, maintenance men and others responsible for maintenance of equipment containing anti-friction bearings.

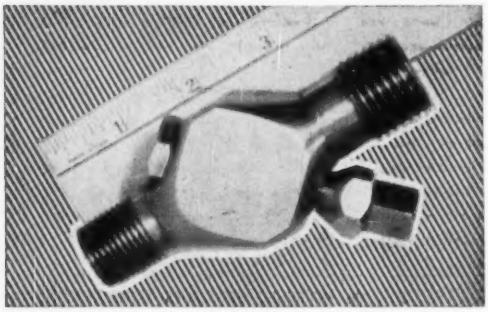
Since many bearing failures are due to mishandling and improper maintenance practices, this booklet is a handy guide to correct shop procedure that can increase bearing efficiency and eliminate many bearing failures. It is profusely illustrated throughout, gives detailed information on the subjects of Bearing Types, Cleaning Bearings, Removing Bearings, Installation, Lubrication, and tips on how to handle and prepare bearings for storage.

Speakers' Booklet

A pocket size manual—"speaking Can Be Easy"—is now available from the Engineers' Council for Professional Development at a cost of 50 cents per copy. The manual has been written by experienced engineering speakers es-


Here's a Tip for Stalled Transmission Designers
Thousands of design engineers have discovered that ROCKFORD CLUTCHES fit compactly into product designs because they deliver maximum torque with minimum bulk and weight. The extensive ROCKFORD line offers you the widest selection of clutch types, sizes and capacities. An experienced ROCKFORD CLUTCH engineer will be glad to make recommendations that will help solve your transmission design problems by meeting your clutch needs exactly. Let him suggest how you can improve that NEW design.
ROCKFORD
Power Take-off
CLUTCHES
ROCKFORD CLUTCH DIVISION
BORG-WARNER
1301 Eighteenth Street, Rockford, Illinois

KIENE®
DIESEL INDICATOR VALVES



KIENE VALVES are designed to give good service under most severe conditions. WILL NOT BLOW OPEN, as valve opens against pressure. The KIENE VALVE HAS EFFECTIVE GAS SEAL when opened or closed, without use of packing or glands.

The KIENE VALVE is SMALL AND RUGGED, 4¼" in length and requiring only 3¼" circle of space for attachment. Has been operated at pressures up to 10,000 psi.

ALL KIENE VALVES have standard indicator plug and wing nut connection. Regularly furnished with male ½" NPT engine connection. Other threads furnished on order. Special adaptions for most Diesel locomotive engines.

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

Reiner
ESTABLISHED 1927
EQUIPMENT THAT'S *Right* ON THE JOB!

Another example of Reiner built-for-the-purpose equipment is this mobile gasoline-driven pump built for the Brooklyn Highway and Sewer Department.

- Reiner equipment is made in a wide range of sizes and types. It includes portable and stationary gasoline, gas and diesel driven generators, pumps and compressors.
- Reiner equipment is engineered to give full economy, efficiency and dependability in operation.
- Reiner's 25 years' experience and worldwide reputation for quality materials and expert workmanship assures you of the very latest in technical design and engineering.

JOHN Reiner & COMPANY
ESTABLISHED 1927

FREE BULLETINS *on standard units sent on request. Write today, stating your requirements*

DEPT. 41, 12-12 37TH AVENUE
LONG ISLAND CITY 1, N. Y.
Cable Address: REINERINC

pecially for the engineer and was prepared by the Committee on Relations With Industry of the ASEE.

The booklet can be read through in 30 minutes and effective organization of the text will enable a reader to cover the important points throughout the manual in five minutes. Check lists for both the speaker and meeting chairman provide help for the improved execution of their respective responsibilities.

Regulator Bulletin

The Allis-Chalmers ⅝ per cent step JFR pole-type regulator designed to correct rural low voltage conditions and improve service is described in a new 12-page bulletin released by the company.

Important features of the regulator that result in trouble-free performance are shown and reasons why it is simple to mount, operate and maintain are given.

There is also a description of how the regulator provides full 10 per cent regulation; how its "Quick-Break" mechanism lengthens contact life, cuts maintenance, and how the entire control for the regulator is contained in one circuit, with voltage supply taken from a potential winding in the regulator.

Reamer Circular

A circular describing the "Blue Helix" reamers made by the Pratt and Whitney Company has recently been published by the firm. The circular contains photographs and descriptions of the various applications of these reamers and includes a table of standard sizes which are available. The reamers are made particularly to machine tough materials. They will cut in heat treated alloys of Brinnell 375 and sometimes harder.

Morse Catalog

The Morse Chain Company, Division of Borg-Warner Corp., in recently announcing a complete packaging program for roller chains and parts has produced a four page catalog insert which gives complete details. All available standard packaged quantities are listed together with package weights and list prices.

Stud Welding

A 16-page illustrated booklet reprinting the chapter on "Stud Welding" from the third edition of the Welding Handbook, recently published by the American Welding Society, is available upon request from the Nelson Stud Welding Division of Morton Gregory Corporation.

The article explains the stud welding method of fastening, describes the equipment and its principal uses, and gives stud locating procedures and other data.

New Tachometers Described

Literature now available from the Electro-Mechano Company outlines the particulars of their line of electric tachometers, including the portable and hand models.

An illustrated page is devoted to each model, specifying the sizes in which it may be obtained, and listing its special features and recommended applications. Scale drawings are shown of the tachometer generators and indicators.

Link-Belt Book

Link-Belt P.I.V. Variable Speed Drives, available in 3 sizes and 16 types, in horsepowers of ½ to 25, with manual and automatic controls, are illustrated, listed and described in a new 88-page Book No. 2274 published by Link-Belt Company.

A special feature of the new book is the convenience with which a P.I.V. of the right specifications for a specific service may now be selected directly from its 36 pages of "Preselected Drives."

Diagrams of automatic speed control applications, and pages of photographs showing a great variety of P.I.V. installations are other features.

Falk Bulletins

The Falk Corporation announces the early release of two new bulletins illustrating and describing the new Falk Concentric Shaft Speed Reducer and Right Angle Shaft All-Steel Speed Reducer. Here are two entirely new speed reducers, with the improved All-Steel housing design which Falk developed to provide more rigidity, greater strength and improved appearance.

These speed reducers, designed for a wide variety of power transmission requirements in almost every industry, are adaptable to: electric motor drives . . . belt drives . . . gas engine drives . . . chain drives, etc. They are suitable for use as a speed increaser or reducer and are rated according to standards of the American Gear Manufacturers Association.

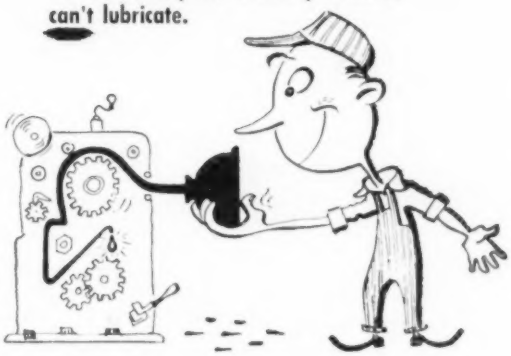
DeLaval Bulletin

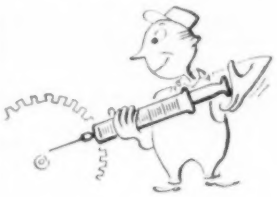
A new bulletin which describes the IMO-De Laval worm gear speed reducers has recently been issued by the De Laval Steam Turbine Co. The bulletin covers all the latest revised AGMA horsepower ratings. It describes how IMO-De Laval worm gears are manufactured, lists types of speed reducers, selection tables, horsepower ratings, overhung load rating tables, dimension tables as well as a section describing vertical speed reducers for cooling tower service.

There is a great deal of valuable information in this 32 page bulletin which should prove to be of interest to many persons in the diesel field.

Manzel

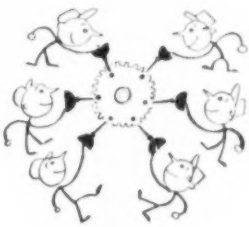
AUTOMATIC FORCE FEED LUBRICATION
reaches vital parts ordinary methods can't lubricate.





Meters the precise amount of oil needed.

Gives each wearing point a full-time 'oiler'.



Frees manpower for more productive jobs.

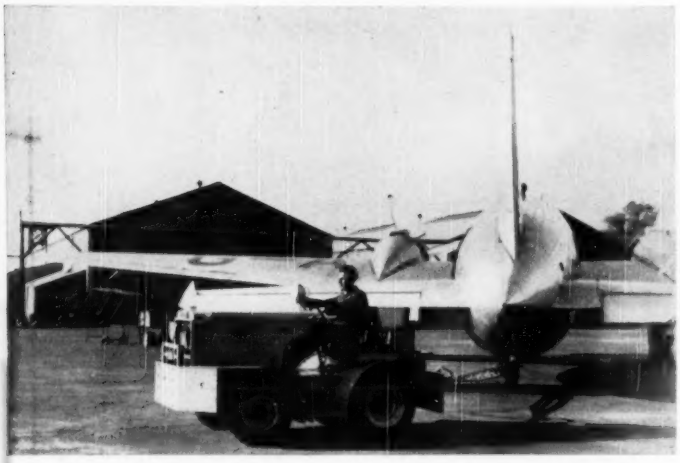
Manufacturers using Manzel Lubricators report that they save their initial cost many times over in reduced labor cost, lower oil consumption, and fewer breakdowns. "Manzels" are standard equipment on many makes of engines, pumps, compressors, hydraulic presses, conveyors, and other machinery. Or...you can install them on present equipment.

Manzel representatives will gladly supply technical assistance on lubrication problems.

Manzel

Division of
FRONTIER INDUSTRIES INC.
271 BABCOCK ST.
BUFFALO, N. Y.

Field Notes



British Diesel Tractors Tow Aircraft

In England, aircraft engineers drew up minimum specifications of their needs for a satisfactory airport tractor and the Mercury Truck and Tractor Co., Ltd. with nearly thirty years experience of building railway switching tractors and heavy industrial trucks produced a vehicle designed to fill the bill.

To tow a big aircraft weighing up to 60 tons requires a heavy vehicle; it must, however, be low enough to pass under airplane wings, have unobstructed view in all directions, and be very maneuverable. Working in all climates, night and day, it must be weatherproof and easy to start. Speed must range from "inching" to a serviceable 15-16 mph. It must be able to carry four or five ground crew, and should have a suspended rear axle to prevent road shocks from being transmitted to the aircraft. For night work, intelligently planned lights are essential. Above all, in view of the long work hours, the ideal tractor must be economical and easily maintained.

The "Mercurys" are powered by a Perkins 4-cyl. diesel developing 46 bhp. at 2200 rpm. In addition to meeting all other requirements, diesel power provides reduced fire hazard.

Records show that with the long hours put in by the team of nine Mercurys currently used at Northolt the extra initial cost of diesel units will be more than offset in a matter of a few months by reduced fuel and maintenance costs.

Modern airport practice tends steadily towards towing instead of taxi-ing. When jets take over from propellers there will be no more taxi-ing, and the aircraft tractors will assume added importance.

G-E Service Shop

Construction of new and expanded repair, maintenance, and warehousing facilities for improving service to users of General Electric apparatus in the Rocky Mountain area has been completed in Salt Lake City, according to L. M. Stauffer, Manager of the Company's Salt Lake City Office.

Dedicated on June 22 by Mayor Earl J. Glade of Salt Lake City, these facilities, located at 301 South Seventh West Street, will be used to service equipment for mines, smelters, power companies, and industrial concerns in Utah, Idaho, Montana, and Nevada.

These facilities provide approximately 50 per cent more warehouse space, Stauffer said, and more than double the former capacity for service and repair of motors, control devices, generators, transformers, switchgear, and other types of electrical apparatus.

Deep Rock Progress

Major units of the multi-million dollar modernization program at Deep Rock Oil Corporation's Cushing refinery are virtually completed with the new cat cracker on full stream, W. J. Carthaus, Vice President in charge of the Company's Manufacturing and Research Division, said in Tulsa recently.

Started in 1949, the new plants and equipment, expected to be in full operation by autumn, will increase the Cushing refinery's daily crude capacity from 12,000 barrels to 18,000, and bring gasoline manufacturing facilities up to equal the best in the industry, Mr. Carthaus said.

Included in the modernization building are a fluid catalytic cracking plant, new crude oil topping unit, research and development laboratories, office building addition and refinery auxiliary units.

Caterpillar Announcement

Caterpillar Tractor Co. has announced that six of its diesel engine line . . . D13000, D397, D364, D336, D375 and D318 . . . are approved for emergency standby fire protection applications by Fire Underwriters Laboratories, Inc., a non-profit testing organization sponsored by the National Board of Fire Underwriters.

The company announcement added that these engines may now be installed with direct connected fire pumps for the purpose of supplying factories and other buildings with water in case of fire. Installations such as this usually operate as auxiliaries to other fire fighting equipment and fire protection devices. They utilize a separate water supply, such as a river, creek, well, or a different water main from that supplying the building, to insure two sources of water at a time of fire.

Maintenance Officers' Program

The preliminary program for the annual meeting of the Locomotive Officers' Maintenance Association at the Hotel Sherman, Chicago, has been announced. The annual meeting is scheduled to be held September 18-20 inclusive.

The preliminary program is scheduled as follows:

Monday, September 18:

Address on Recommended Tonnage Ratings and Their Relation to Diesel Maintaince

Diesel-General

Diesel-Mechanical

1. Program vs. Term Diesel Locomotive Maintenance & Cost Accounting for Same
2. Air & Oil Filter Maintenance
3. Steam Generator Maintenance

Tuesday:

Personnel Training

1. Technical Training of Diesel Supervisors Shop Tools
2. Tools & Methods for Diesel & Steam Locomotive Wheel and Tire Turning & Other Maintenance Carbide Tools

Wednesday:

General Terminal Facilities and Terminal Facilities—Diesel:

1. Facilities for Diesel Locomotives at Outlying Points
2. Types of Ventilation in Diesel Shops

Terminal Facilities—Steam

1. Improving Steam Locomotive Performance Through Laboratory Standing and Road Tests

Shop Practices; Diesel and Steam

1. Roller Bearing Maintenance Facilities & Practices
2. Cleaning and Painting Diesel Locomotives
3. Diesel Parts Repair—Separate Shop vs. Regular Maintenance

Diesel Electric

1. Traction Motor Armature Bearings
2. Main Generator & Traction Motor Flash-Over & Prevention
3. Grease vs. Oil Lubrication in Anti-Friction Bearings
4. Dust Proofing Electrical Control Equipment

Persons interested in attending the meeting should contact:

C. M. Lipscomb
Secretary-Treasurer
Locomotive Maintenance Officers' Association
1721 Parker Street
North Little Rock, Ark.

to obtain additional information concerning arrangements for attending the meeting.

Diesels for Guatemala

Six 120-ton, 1200-hp. diesel-electric locomotives were built by the General Electric Company for shipment to Guatemala. These are the highest horsepower diesel-electrics for 36-in. gage ever built in single cab units by G.E.

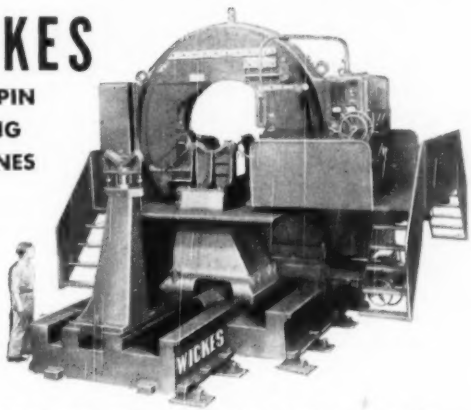
The locomotives will be used in tandem, two units at the head of the train and two "helpers" in the middle. A total of 4800-hp. will be available on a single train. The use of this amount of horsepower on a 36-in. gage track is most unusual. Through use of a dynamic braking system, two units will be able to bring the empty train back down the grade to the coast.

This equipment is required for

INCREASE PRODUCTION FOUR TIMES!

ROUGH AND FINISH TURN LARGE HEAVY CRANKPINS IN ONE-FOURTH THE TIME REQUIRED ON ENGINE LATHES WITH

WICKES
CRANKPIN TURNING MACHINES

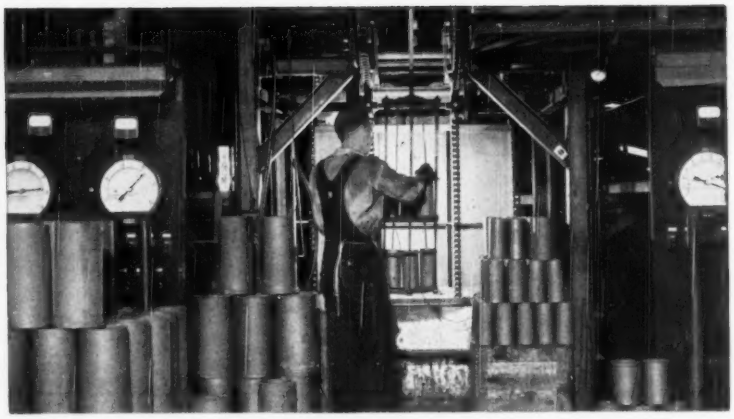


Wickes Crankpin Turning Machines will completely cheek, turn, and fillet crankpins and bearings from rough forgings (or solid billets) to finish sizes with .001" accuracy, in one-fourth the time ordinarily required by engine lathes! Rotating tools about a rigidly supported crankshaft make possible greater speeds, coarser feeds and a finer lapping and polishing operation. Wickes Crankpin Turning Machines are available in five sizes for machining crankpins and bearings with diameters from 4" to 24". Write for descriptive literature.

WICKES BROTHERS • SAGINAW, MICHIGAN
ESTABLISHED 1854 • DIVISION OF THE WICKES CORPORATION

Complete line of Crankshaft Turning Equipment • Thread Milling Machines • Heavy Duty Engine Lathes • Special Production Lathes • White Printing Machines

Centrifugal found a way...



. . . TO CUT YOUR SLEEVE COSTS — *YET INCREASE SLEEVE LIFE AND PERFORMANCE!*

Specify

Centralloy

Ten alloys — for sleeves and piston rings. Castings rough machined to specifications. Write for "Revolutionary Results" and/or sample castings.

Yes, at low cost here's a sleeve of high physical properties that mean oil economy, prolonged engine life, higher compression and lower maintenance cost to your engine. Result of Centrifugal's patented, heat treatment process and special closely controlled composition. In addition to low original cost, other savings result because castings are free from primary cementite or objectionable free ferrite; are easily machined to steel-like finish free from hard spots and distortion; are low in scrap losses (as low as 1.5%). No wonder more and more of the nation's leading engine builders are specifying Centralloy.

CENTRIFUGAL FOUNDRY COMPANY
MUSKEGON, MICHIGAN
Centrifugally cast electric alloys — heat-treated by patented process for Super Duty.

heavy hauls on the International Railways of Central America where grades from the lowlands to the summit of the Continental Divide range up to 3.6 per cent. The locomotives were purchased by the Maritrop Trading Corporation for United Fruit's subsidiary, Compania Agricola de Guatemala.

Erie Diesel Order

The Erie Railroad took a long forward step toward complete dieselization of all its operations when its directors recently authorized immediate purchase of 62 diesel locomotives costing more than $10\frac{1}{2}$ million dollars.

This is the largest single diesel order ever placed by the Erie. It will bring its steadily growing diesel fleet to 253 locomotives before the end of the year. There are now 178 in service and 75 on order.

Addition of the 97,000 horsepower included in the new order will reduce the number of coal-burning engines to 206, the lowest steam power census since 1855 when the Erie owned 203 locomotives. Six years ago, before the Erie embarked on its diesel program, there were 751 steam locomotives on its roster.

Already known among eastern railroads for its high percentage of diesel ownership, the board action is expected to establish the Erie as a leader in diesel operation by America's rail carriers. Coal-burning engines will be completely eliminated from 11 divisions between Meadville, Pa., and Suffern, N. Y.

Baldwin-Lima-Hamilton Merger

Marvin W. Smith, President of The Baldwin Locomotive Works, and George A. Rentschler, Chairman of the Executive Committee of Lima-Hamilton Corporation, have jointly announced that the Board of Directors of their respective companies have approved the substance of a plan to consolidate the operations of the two companies under the name of Baldwin-Lima-Hamilton Corporation. The plan will provide for the issuance of Baldwin-Lima-Hamilton Corporation common stock on a share for share basis to Lima-Hamilton stockholders for the assets of Lima-Hamilton subject to its liabilities.

Prior to the consolidation, The Baldwin Locomotive Works will transfer to a subsidiary company its principal "investment" securities consisting of its common stockholding of The Midvale Company, General Steel Casting Corporation and the net proceeds from the recent sale of its common stock of Slannery Bolt Company, amounting to approximately $690,000. The stock of such subsidiary company will be distributed to Baldwin stockholders as a dividend.

The plan is subject to working out all necessary details and to required action by the stockholders of both companies. It is proposed that George A. Rentschler will be Chairman of the Board and Marvin W. Smith, President of Baldwin-Lima-Hamilton Corporation.

The principal products of the two companies supplement each other and will result in better diversification. In the diesel electric locomotive field there should be substantial advantages in integrating the activities of the two organizations.

How to Stop DIESEL TROUBLES Before They Start

The compression-ignition principle of Diesel engines makes regular checks of compression of all cylinders vitally important. Maintaining correct compression pays off. It means keeping your Diesels running at peak efficiency. The result is greater operating efficiency, longer engine life, and lower maintenance costs.

The MOTORITE Diesel Compression Tester simplifies checking compression pressure. It is easily attachable to any make of Diesel by means of an interchangeable adapter which takes place of the fuel injector. In addition to a "universal" adapter which serves more than 50 makes and types of Diesels, we have a complete line of special adapters for practically every commonly-used Diesel engine.

Ask your engine parts jobber to show you the MOTORITE Diesel Compression Tester and our other Diesel testing instruments, or write for Bulletin 612.

BACHARACH Industrial Instrument Company
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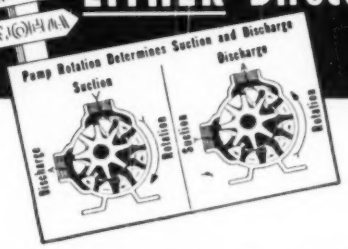
VIKING ROTATES in EITHER Direction



With Equal Efficiency! . . . Equal Accuracy!

You merely reverse rotation of pump shaft to reverse flow of liquid in the Viking Rotary Pump. Figure at left shows pump with TOP SUCTION and SIDE DISCHARGE . . . at right, after reversing, SIDE SUCTION and TOP DISCHARGE. Simple and practical isn't it? And this flexible, time-saving feature makes Viking the ideal pump for diesel fuel and lubricating oil service.

Bulletin 2201D shows you how the "2 in 1" Viking Pump can cut pumping costs and time. Write for a copy.

VIKING
AN HONORED NAME IN PUMPING

VIKING PUMP CO. Cedar Falls, Iowa — See Our CATALOG IN SWEETS

"Buffalo" AXIAL FLOW FAN

- Relatively high-velocity delivery — ideal for cooling action!
- "Bee-Line" design means high efficiencies in small-space fans!
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- Widely used in the expanding Diesel market!
- WRITE FOR BULLETIN 3533-C!

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140 Mortimer Street — Buffalo, New York
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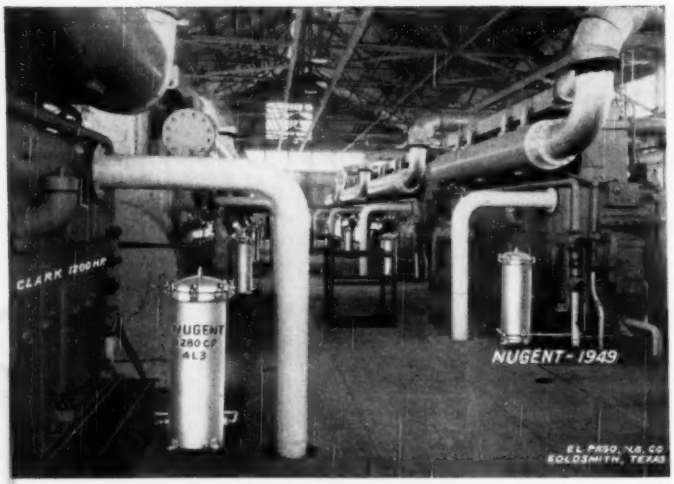
Clean oil means longer compressor life



with NUGENT ABSORBENT OIL FILTERS

Nugent Absorbent Oil Filters get out more of the harmful impurities that get into oil—99.8% by actual test and cleaner oil means that engines, compressors and all machinery will last longer and require less maintenance, while at the same time require less frequent replacement of oil.

Fig. 1280CP, the Nugent Filter type shown above installed on engine-compressor units at the Goldsmith, Texas, station of the El Paso Natural Gas Company, is typical of Nugent depth type pressure liquid filters. The filtering material generally used is a superior quality of cotton waste, wool, excelsior, asbestos or cellulose. No chemicals, bleaches or filtering earths are used. All units have very large capacity for their size. Fig. 1280CP is available in a wide range of capacities. Write for complete information.

Other Nugent filters are available to meet virtually every need.

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OIL FILTERS, OILING AND FILTERING SYSTEMS, TELESCOPIC OILERS, OILING DEVICES, SIGHT FEED VALVES, FLOW INDICATORS

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Alcoa Anti-Trust Decision

After more than 13 years in the courts, the government's anti-trust case against Alcoa has finally been settled with the company being exonerated of the various charges that had been leveled at it by the government's lawyers. The firm has prepared an analysis of the decision recently rendered by Judge Knox of the Federal District Court for Southern New York and has made copies available.

The salient points covered in the decision were:

1. The Department of Justice request that Alcoa be required to sell some of its plants and facilities was turned down because, according to the Court, price domination on the part of Alcoa had not been established and that there was no reason to believe that Reynolds and Kaiser would not continue to thrive and prosper.

2. Alcoa's purchase of the government's St. Lawrence smelting plant was sustained with title to pass to the firm this month and plans already made by the firm to put the plant into operating condition as promptly as possible.

3. Alcoa's patent structure and royalty terms were upheld.

4. Those who own substantial stock in both Alcoa and Aluminum Limited are required to sell their stock in one company or another. It is pointed out that this will have no effect on company policy since the two firms have at all times competed vigorously.

5. The Court retains jurisdiction of the case for five years in order to enable the government to petition the Court for further relief in the event that present competition with Alcoa should become feeble, unlikely in view of what is said about these firms in (1) above.

Link-Belt Expands Public Relations

Link-Belt Company announces that its Public Relations activities are being expanded, and that a separate Public Relations Department has been established at executive headquarters, 307 N. Michigan Avenue, Chicago, headed by Harlan B. Collins, Secretary of the company and Russell B. Kern.

Pritchard's NEW Quintair*

AIR COOLED HEAT EXCHANGER

For Low Cost, Dependable Cooling of Engine Jacket Water and Lubricating Oil

- Lower Installed Cost
- Higher Efficiency
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- Many Industrial Uses

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Mr. Kern has long been supervising the company's Public Relations activities, which have been part of the Advertising Department. He will continue in the capacity of Editor of Link-Belt News, the company's house magazine devoted to the application of materials handling and power transmitting machinery for solving the modern problems of industry.

The Advertising Department, under the direction of Julius S. Holl, Advertising Manager, has been strengthened by the appointment of Bertram V. Jones as Executive Asst. Advertising Manager. Mr. Jones will be directly assisted by John F. Kelly, Asst. Advertising Manager.

Fram Training Program

Fram Corporation, manufacturer of automotive oil, air and fuel filters, this year inaugurated a new type of sales training course for district managers. Concentrated within two weeks, the course, designated as the Fram Institute of Filtration, incorporated a thorough review of company products policies, marketing and distribution, advertising, merchandising and selling techniques.

District managers were divided into three groups and the two-week course repeated for each group. Thus, every man in turn was brought in from the field for the institute, without noticeable interruption to normal activities in the corporation's over-all operation.

Under the direction of Malcolm McCormick, vice president in charge of market research, who planned, coordinated and executed the program, the teaching staff included Dr. William S. James, vice president and director of engineering research; Paul Huber chief research engineer; H. G. Kamrath, chief liquid filter engineer; other members of the engineering staff; Howard E. Robinson, sales manager, and members of his staff. C. M. Buchanan, vice president of VanSant, Dugdale & Company, Fram's advertising agency, conducted a session on advertising; and Donald McKellar, of Providence, gave a course in public speaking and salesmanship.

Aluminum Nomenclature

To clarify the designation of aluminum sheet and plate, the Sheet Division of The Aluminum Association has adopted standard nomenclature for these products, Donald M. White, sec-

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HAVE YOU A JOB FOR A TRAINED MECHANIC?

We have a number of alert young men who have completed intensive training in Diesel Mechanics. They learned their trades thoroughly by working on actual equipment under personal, expert supervision. If you need a trained man, we invite you to write for an outline of our course, and for a prospectus of the graduate. No fees, of course. Address:

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Quality Precision Crankshafts
For Diesels – Since 1910 . . .

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CRANKSHAFTS - CONNECTING RODS
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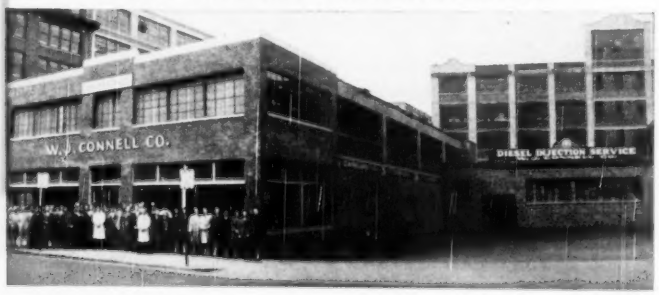
NEW ENGLAND HEADQUARTERS
FOR DIESEL ACCESSORIES



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There's a reason why we've grown—since 1904—to be the automotive and Diesel leaders in this busy New England area. A recognized service organization geared for fast, intelligent handling of your specialized maintenance problems.

Carburetor—Diesel—Electrical
SERVICE

W. J. CONNELL CO.
121 BROOKLINE AVENUE BOSTON, MASS.

retary of The Association, has announced.

The following definitions were adopted:

(1) Plate is a solid section rolled to a thickness of 0.250 inch and heavier, in rectangular form with either sheared or sawed edges.

(2) Sheet is a solid section rolled to a thickness range of 0.006 inch to 0.249 inch inclusive, supplied with sheared, slit, or sawed edges.

a. Flat Sheet is furnished in rectangular form with sheared, slit, or sawed edges, which may be flattened by any standard method.

b. Coiled Sheet is furnished in rolls (coils) with slit edges.

Heretofore, the terms "strip" and "coiled sheet" were applied interchangeably to the same product, but the new nomenclature officially recognizes the latter, more descriptive term.

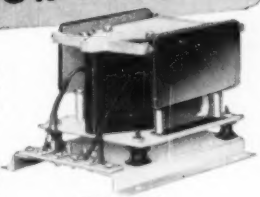
Cooper-Bessemer Supercharger

Large capacity engine superchargers are now being built by The Cooper-Bessemer Corporation at its plant in Mount Vernon, Ohio. Designed specifically for Cooper-Bessemer type LS and LSV engines, the new superchargers are of such size and design as to handle the requirements of any gas or diesel engine from 1200 hp. to 2500 hp., according to Ralph L. Boyer, Cooper-Bessemer Vice President and Chief Engineer.

"Cooper-Bessemer's decision to manufacture engine superchargers results from its inability to secure superchargers of such large size in this country," explains Mr. Boyer. Cooper-Bessemer's experience with exhaust driven superchargers dates back to 1935 when such superchargers were first introduced in this country by a European manufacturer and installed on Cooper-Bessemer equipment. Since that time, every effort has been concentrated on the design of both engines and superchargers to achieve the ultimate in engine output and efficiency. To this end, Cooper-Bessemer has engaged the services of John Fulleman, internationally recognized authority on supercharging.

Burlington

GENERATOR VOLTAGE REGULATOR TYPE WA



Designed for use in regulating the voltage of A.C. generators in Stationary, Mobile or Marine installations.

Direct rheostatic action provides a simple, effective and automatic means of regulating voltage by performing the function of an automatic field rheostat.

Rating of rheostatic element is 2 amperes maximum exciter shunt field current at full load sigma watts is 50 watts.

FEATURES

- Direct Acting
- Fast Response
- Automatic Control
- Small, Compact, Self Contained
- Rugged Construction
- Rheostatic Action
- Inexpensive

Inquiries for complete information and engineering services solicited.

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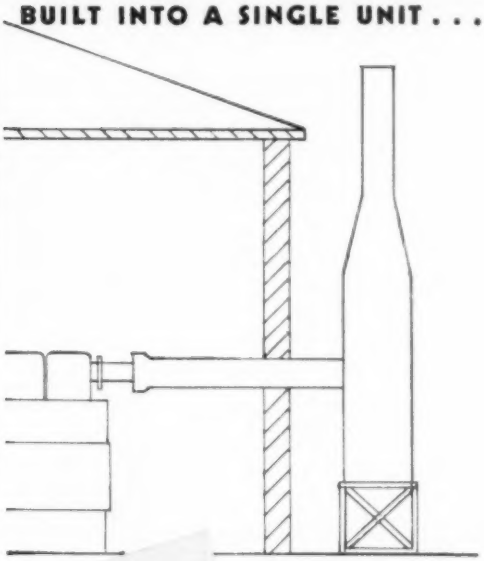
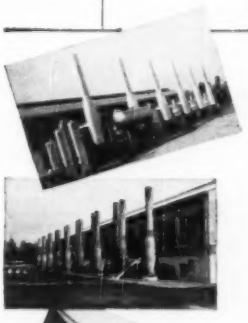
DEPT. B-90
BURLINGTON, IOWA

ADEQUATE SILENCING

BUILT INTO A SINGLE UNIT . . .





A single silencer outside and only the exhaust piping inside — a space saving installation — and a flexible one because exhaust can be run high, low, or underground with the Maxim Air Induction Silencer. The inlet can be placed where you want it. Hot air is drawn out of the engine room, and piping and silencer are both cool so that paint will stay on. Investigate this *most practical* way to get adequate silencing and engine room ventilation.

SEND FOR BULLETIN

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93 HOMESTEAD AVE. HARTFORD 1, CONNECTICUT
Please send AIR INDUCTION SILENCER bulletin.

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COMPANY _____
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BE SURE IT'S A

MAXIM

THIS SMALL PUMP CAN DO BIG THINGS FOR YOU

IN PRESSURE LUBRICATION

ON HYDRAULIC MECHANISMS

FOR FUEL OR LIQUID TRANSFER

It's the Tuthill Model L . . . a positive displacement, internal-gear rotary pump with the famous Tuthill mechanical seal. Capacities up to 3 g.p.m. at pressures to 400 p.s.i. Ring or foot mounting. Many porting arrangements. Write for Model L bulletin.

TUTHILL PUMP COMPANY
939 East 95th Street, Chicago 19, Ill. Phone: REgent 6-7420

SING A SONG OF SAVINGS!

THE WAY PORT CHESTER DOES!

For over fourteen years the Lister-Blackstone Diesel in Port Chester, N. Y.'s sewage disposal plant served and saved. For 12 hours a day at peak load — and for emergencies when flash-floods knocked out power lines. And after fourteen years . . .

ANOTHER L/B for P/C!

So satisfied were Port Chester engineers that when re-engining was decided upon *another Lister-Blackstone of exactly the same model and horsepower was specified!*

SING A SONG OF SAVINGS WITH LISTER - BLACKSTONE — a song of trouble-free service and economy you'll enjoy down the years.

NEW REDUCED PRICES

give you best diesel value for your dollar. 3 to 480 h.p. Write us your requirements. Address T.

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Parts Warehouses:
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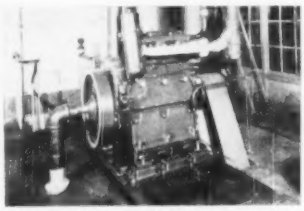

Lister-Blackstone model 27-3 30 h.p. diesel driving Port Chester's 2000 g.p.m. sewage disposal pump.

Sewage Disposal Plant, Port Chester, N. Y.

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MIAMI • JACKSONVILLE • SAN ANTONIO
DALLAS • HOUSTON • NEWTON (Iowa)
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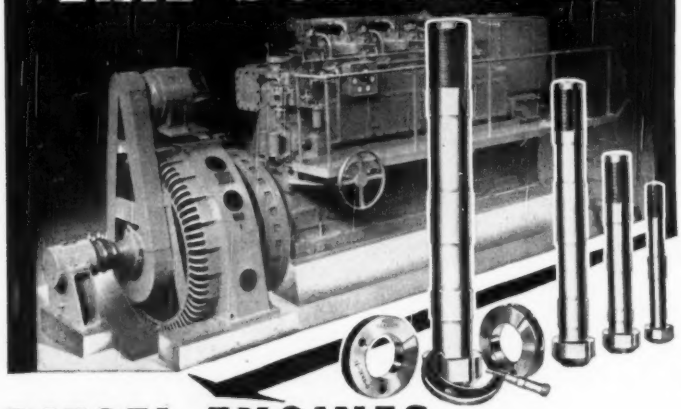

DIESEL ENGINES

For over 30 years ERIE has manufactured bolts and studs to the specifications of Diesel Engine builders. This specialized experience gained in working with leading Diesel designing engineers assures you of getting the exact materials and the precise tolerance in bolting desired for your Diesel. Send us your specifications for Diesel Connecting Rod Bolts, Cylinder Head Studs, and other special bolting. Write for new price and data book.

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STUDS • BOLTS • NUTS ~ ~ ALLOYS • STAINLESS • CARBON • BRONZE

Furfural Process Use

The first commercial use extraction unit employing furfural as the solvent and specifically designed for the production of diesel and domestic heating fuels was announced recently by Michael Halpern, vice president in charge of refining, The Texas Company. Widely used by the oil industry for the removal of sludge producing elements in motor oils, the furfural process has been adapted to the new use in a commercial unit operated by The Texas Company at its new $60,000,000 refinery at Eagle Point, New Jersey, Halpern reported.

He said that the basic value of the new application is seen in substantial improvement of cetane number in diesel fuels, improved burning quality of domestic heating fuels, and the reduction in sulphur content of all products. It is firmly believed that this offers a solution to a major oil industry problem.

He said that the new use resulted from growing demands for quality gas oils for high speed diesel fuels, domestic heating fuels, and catalytic cracking charge stocks — combined with the need to utilize high sulphur content crude oils.

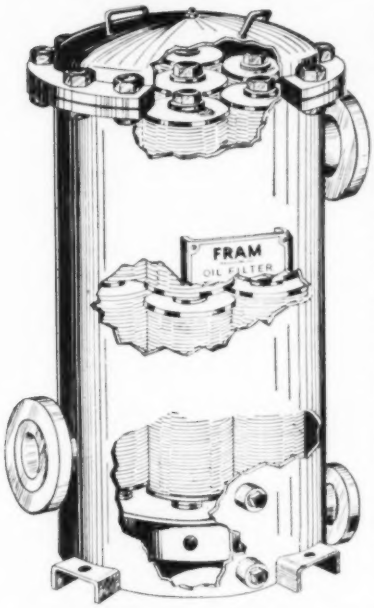
Brown Instrument Courses

Brown Instruments division of Minneapolis-Honeywell Regulator Company will open its second half of 1950 maintenance and repair courses on August 14.

"The courses will again be fitted to the specific requirements of customers who will send employees to the Brown School;" said M. J. Ladden, chief instructor. "Classes will be held on a three, five and 13 weeks basis. The shorter courses will be for concentrated product instruction, the longer courses for more comprehensive training in complete industrial instrumentation."

The three-week course will start on August 14 and run to September 1. It will include training in pyrometry, ElectroniK potentiometers and pneumatic automatic control. The five-week classes, starting September 11 and October 30, will include the same subjects, also pneumatic transmission, flow

FRAM FILTERS *Cut Costs...*



Extend Overhaul Periods

Read this 3 year performance record . . .

AT Springfield Bronze and Aluminum Co., Springfield, Mass., overhauls used to be required every 8000 hours on their 100 h.p. Diesel generator. Today, under the same grueling 24-hour running conditions, Fram Filters have extended overhauls to 20,000 hours.

GOOD CONDITION

Previous overhauls showed piston rings in poor condition, all at least partially frozen. Lube oil was black, dirty, laden with contaminants. Since installing Fram, the last overhaul was made after 833 days of continuous operation. The general condition of the engine was very good with "blow-by" at a minimum.

CUTS LUBE COSTS

The company calculated that the average cost of keeping lube oil clean to a .01 naphtha insolubles standard is 2 cents per hour, with oil change periods of 1000 hours compared to oil changes every 200 hours as previously required.

WRITE TODAY . . . Let Fram's Research Department help you determine how Fram Filcron Filters can give you lower operating costs and increased efficiency. You're sure of top performance because Fram Filters are *unconditionally guaranteed*. Write the Fram Corporation, Providence 16, R. I. *In Canada:* J. C. Adams Co., Ltd., Toronto, Ontario.

FRAM *Filcron*

THE MODERN OIL FILTER

meters, thermometers, pressure gauges and hygrometers.

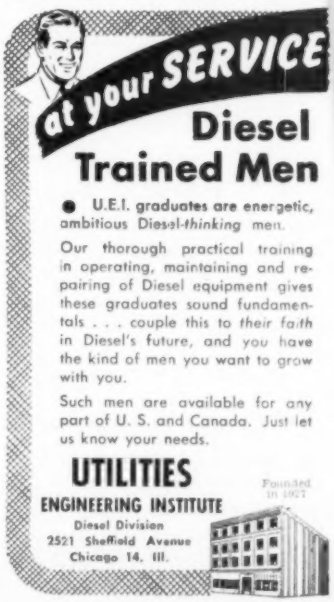
The comprehensive 13-week course, to be held from September 11 to December 8 will take up studies of millivoltmeter-type pyrometers, continuous balance, ElektroniK potentiometers, electrically-operated automatic control, flow meters, thermometers, pressure gauges, hygrometers, air-operated automatic control, Moist-o-Graphs, tachometers, resistance thermometers, gas analysis, pH and conductivity instruments.

All classes will be conducted at the company school in Philadelphia, Ladden said. The industries for which special process instrumentation classes will be held will be announced upon completion of the full schedule.

Power Show

New developments in the power field will be presented at the 19th National Exposition of Power and Mechanical Engineering in Grand Central Palace, New York, November 27 to December 2. The Power Show, as it is generally known, will be held under the auspices of the ASME in conjunction with the Society's annual meeting at that time.

The Advisory Committee for the exposition has recently been announced. Irving E. Moultrop, of Boston, again is chairman of the committee, and John H. Lawrence, of New York, is vice-chairman. Both Mr. Moultrop and Mr. Lawrence are consulting engineers widely known in their field. Mr. Moultrop is an honorary member of the Boiler Code Committee of the American Society of Mechanical Engineers and Mr. Lawrence is vice-chairman of the Finance Committee of the Society. Other members of the committee include: Lester T. Avery, president, American Society of Heating and Ventilating Engineers; John G. Bergdoll, Jr., president of American Society of Refrigerating Engineers; James D. Cunningham, president of American Society of Mechanical Engineers; C. E. Davies, secretary, American Society of Mechanical Engineers; Chester R. Earle, managing editor, "Power Engineering"; David Moffat Myers, consulting engineer; Joseph Pope, vice-president, Stone & Webster Engineering Corp.; L. N. Rowley, Jr., chairman of the Board on Technology, American Society of Mechanical Engineers; Ralph A. Sherman, director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Diesel Trained Men
● U.E.I. graduates are energetic, ambitious Diesel-thinking men.
Our thorough practical training in operating, maintaining and repairing of Diesel equipment gives these graduates sound fundamentals . . . couple this to their faith in Diesel's future, and you have the kind of men you want to grow with you.
Such men are available for any part of U. S. and Canada. Just let us know your needs.
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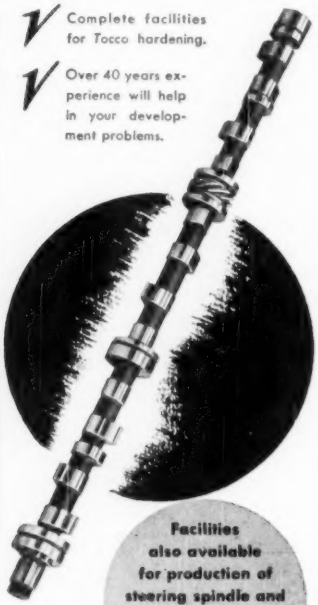
MOTOR SPECIALTIES CO.

for Low-Cost Experimental or Production Runs of Precision

Camshafts

- Rigid adherence to specifications gives you lower installation costs.
- Complete facilities for Tocco hardening.
- Over 40 years experience will help in your development problems.



Facilities also available for production of steering spindle and arm assemblies, spindles, spring hangers, etc.

For complete information about Muskegon Crankshafts and Camshafts, write

MUSKEGON MOTOR SPECIALTIES COMPANY

JACKSON, MICHIGAN

A Subsidiary of

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at large, American Society of Mechanical Engineers; A. Bowman Snavely, chief engineer, Hershey Chocolate Corp.; Philip W. Swain, editor, "Power" and Willis F. Thompson, vice president Westcott & Mapes, Inc., who is also a member of the meetings committee of ASME.

The exposition is under the management of the International Exposition Company, of which Charles F. Roth, manager of the exposition, is president. E. K. Stevens, associate manager, has been active in exposition management for many years.

F-M in Canada

Fairbanks, Morse & Co. and The Canadian Fairbanks-Morse Company Limited of Montreal have recently entered the Canadian railroad diesel locomotive field through the purchase of a substantial stock interest in the Canadian Locomotive Company of Kingston, Ontario—the oldest firm of its kind in Canada, which has a capacity of fifteen steam type locomotives per month.

The directors and stockholders of the Canadian Locomotive Company, at a meeting held June 5th, approved the stock purchase plan which places the control of the future operations of the company with Fairbanks, Morse & Co. of Chicago and The Canadian Fairbanks-Morse Company Limited of Montreal.

Immediately following the stockholders meeting, the directors elected Robert H. Morse, Jr., President and Chief Executive of the Canadian Locomotive Company. Mr. Morse is President of Fairbanks, Morse & Co. of Chicago and Chairman of the Executive Committee of The Canadian Fairbanks-Morse Company Limited of Montreal.

Mr. Morse announced that Fairbanks-Morse officials and engineers will immediately lend all assistance possible to tool up and start making all types of diesel locomotives in the Canadian plant so that delivery can start at an early date.

Baldwin Raises Ratings

As part of an established program of engineering research having as its objective the provision of maximum hauling capacity and flexibility in its

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See our Catalog in Sweet's File for Product Designers.

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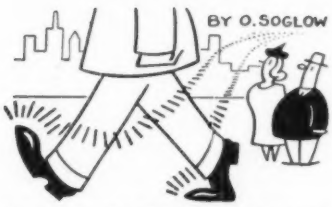

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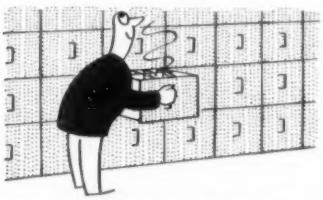

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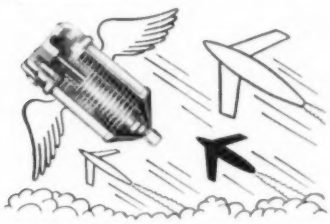

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standard types of diesel-electric locomotives, Baldwin has announced increased horsepower ratings and also increased tractive effort ratings or continuous rating speeds on the complete Baldwin-Westinghouse line. This constitutes the first major revision on all models since the war.

All units are affected and the complete line now includes: 300-hp. and 1200-hp. switchers; 1600-hp. all-service locomotives with either 4 or 6-wheel trucks and with either 4 or 6 traction motors; a 2400-hp. road transfer locomotive; and 1600-hp. road units which can be operated in multiple to form 3200-hp., 4800-hp., or 6400-hp. locomotives. All ratings represent horsepower available for traction.

Optional gear ratios are offered in the 1600-hp. all-service locomotives, in the 2400-hp. road transfer locomotive, and in the 1600-hp. road locomotive units, permitting a wider latitude in the selection of speed and power capacities to suit a particular service.

Of paramount importance from a maintenance standpoint is the fact that these changes have been made without seriously affecting the interchangeability of parts between older Baldwin locomotives and the new units.

GM Manager

Appointment of Roger M. Kyes as general manager of the GMC Truck & Coach Division of General Motors was announced recently by C. E. Wilson, president.

Mr. Kyes, assistant general manager of GMC Truck & Coach since last October, succeeds Morgan D. Douglas, who is taking a leave of absence because of his health.

Mr. Douglas has been with General Motors for 35 years. He served with the Chevrolet organization for 30 years, including 16 years as general parts and accessories manager, before his appointment as general manager of the GMC Truck & Coach Division five years ago.

Mr. Kyes joined General Motors in August, 1948, and served as director of its central office Procurement and Schedules Staff until his appointment to the GMC Division in October, 1949.

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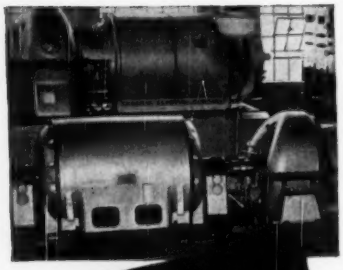

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- **Cleaning hard-to-reach places by Steam-Detergent Gun**

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Chain Belt Change

Chain Belt Company of Milwaukee, announces the appointment of Marshall E. Cusic as a District Sales Engineer with headquarters at the Pittsburgh District Office, 1101 Grant Building, Pittsburgh 19.

Mr. Cusic, a graduate of Purdue University with a degree in Mechanical Engineering, joined Chain Belt Company in 1937. After completing a comprehensive training program, he was assigned to the methods and standards department of the Rex Chain and Transmission Division. In October, 1941, he left the company to enter the the U. S. Army and participated in the Anzio and Southern France Invasions.

Upon rejoining Chain Belt Company in 1945, Mr. Cusic was assigned to the Rex Chain and Transmission Sales Department where he served as Assistant Sales Manager.

Electric Machinery Changes

R. H. Olson, formerly vice president in charge of sales of Electric Machinery Mfg. Company was recently elected president of the company. He succeeds W. H. Feldman who joined the Worthington Pump and Machinery Corporation as vice president in charge of sales for the Corporation. Electric Machinery is a subsidiary of Worthington.

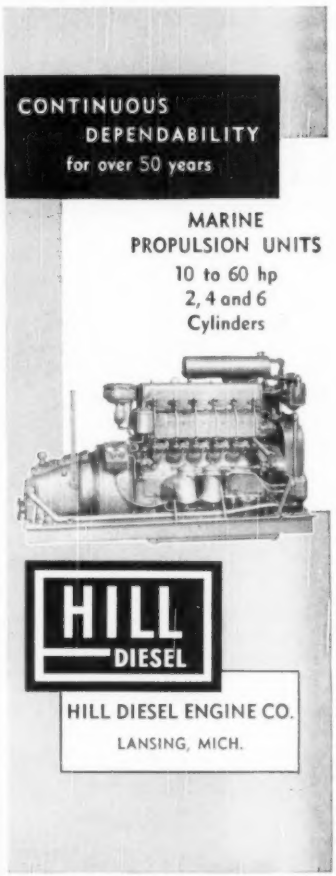
A. P. Burris, formerly manager of the New York sales district was elected vice president in charge of sales to succeed R. H. Olson. P. L. Shawley, of the New York office, has been appointed New York district sales manager.

Olson and Burris are both graduates in electrical engineering from the University of Minnesota, joining the firm in 1919 and 1930 respectively. P. L. Shawley is a graduate of the University of Michigan in electrical engineering and has been with E-M since 1927.

Blackmer Sales Appointment

B. L. Gordon, president, Blackmer Pump Company announces the appointment of G. W. Stahl, as Division Sales Manager. Mr. Stahl will direct distribution of Blackmer Rotary Pumps through jobbers in Illinois, adjacent counties in Indiana and Iowa, and in part of Kentucky.

With Mr. Stahl's appointment, Blackmer Pump Company has established new jobber service outlets for the complete line of rotary power



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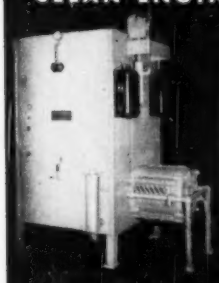

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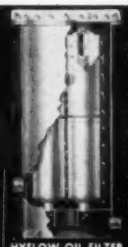

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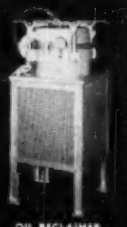

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Worthington Appointment

H. C. Ramsey, President of Worthington Pump and Machinery Corporation has announced that Mr. Charles A. Butcher joined the organization June 1st as Assistant to the President. Mr. Butcher formerly was General Manager of Crocker-Wheeler Electric Manufacturing Company, and Vice President of its successive parent companies, Joshua Hendy Corporation and Elliott Company. He will make his headquarters at 2 Park Avenue, New York, N. Y.

Caterpillar Manager

T. R. Farley, Vice President of Caterpillar Tractor Co., Peoria, Illinois, has been named General Manager of Caterpillar's new plant to be located two miles southwest of Joliet, Illinois, according to an announcement by L. B. Neumiller, Company president.

Mr. Farley was born in Ipswich, Massachusetts. After serving three years in World War I, he joined the Holt Manufacturing Company at Peoria, Illinois, in June 1919 and since that time has acquired an un-

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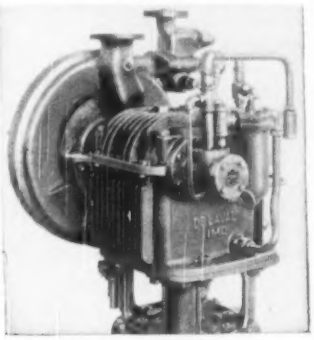

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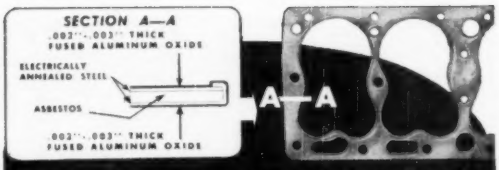

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Vellumoid Appoints O'Neil

The Vellumoid Co., Worcester, Mass., announces the appointment of Thomas G. O'Neil as general sales manager.

O'Neil joined the sales force of the company in 1932. Except for 3½ years during the war, when he served in the Pacific as Lieutenant Commander in Naval Air Combat Intelligence, he has been with the Company ever since.

C. S. Livingstone, who has handled the sales of the company for many years, will continue as vice president and director of the company.

Enterprise General Manager

Appointment of Paul I. Birchard as vice-president and general manager of Enterprise Engine & Foundry Company, has been announced by the company at its San Francisco headquarters.

Birchard has been identified with the diesel engine industry for over 20 years, and has been associated with

Enterprise since early in 1946.

During the last war, Birchard served as a Navy Commander in charge of a Midwest Navy shipyard. It was following this duty that he joined Enterprise as assistant to the executive vice-president. In the same year he became head of production at Enterprise's South San Francisco plant, and subsequently general works manager. Since January, 1948, he has been vice-president in charge of engineering and manufacturing.

Winslow Appointment

Appointment of W. Ray Kern as sales manager of Winslow Engineering Company has been announced by Wm. G. Nostrand, vice-president in charge of sales and engineering for the firm.

Mr. Kern assumed his new duties on May 15 after resigning as vice-president and general manager of Berglund Tractor and Equipment Company. He had spent the past fifteen years with the Berglund organization, which under his leadership had become one of the most successful distributors of Caterpillar tractors and P & H excavators in the nation.

Organizational Briefs

Louis R. Botsai has been appointed as manager of the Westinghouse Motor and Control Division, Buffalo, N. Y., succeeding Leon R. Ludwig who has been appointed to the staff of John K. Hodnette, vice-president of Westinghouse. . . . Patrick M. Carmondy has been made manager of the Socony-

Vacuum Oil Company's Lubrite division, covering 10 mid-western states with headquarters in St. Louis. . . . Harlow F. St. Pierre, formerly assistant sales manager, has been appointed manager of the industrial sales division of Hunt-Spiller Manufacturing Corp. . . .

S. W. Collins is the new sales representative for Alloy Steel Products Co. in the states of Oklahoma and Kansas. His offices are located at 419 Ritz Building, Tulsa 5, Okla. . . . Ampco Metal has announced the appointment of Alfred D. Jenss as District Manager of their Cincinnati office.

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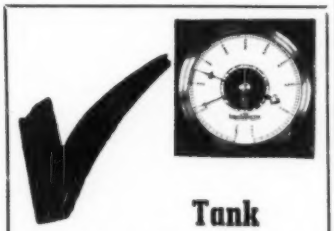

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. . . Donald D. Fitz has been named Iowa sales and service representative for the D-A Lubricant Co. His headquarters will be in the Blue Line Storage Co., 200 Elm St., Des Moines, Iowa. . . .

Atlas Mineral Products Company changes include Richard A. Weppner as sales engineer for corrosion-resistant chemical construction materials in Del., Md., Va., and parts of W. Va. and N. J.; Phillip E. Berens is the new sales representative for corrosion-resistant materials in Eastern Pa., Western N. Y., and parts of N. J.; William A. Streaker has been appointed sales engineer for corrosion-proof materials in the lower peninsula of Mich., Eastern Ind., and Lucas County in Ohio. . . .

Penn Industrial Instruments Corp. announces the appointment of James W. Bennett as General Sales Manager. . . . Evans L. Shuff and Associates are the new representatives for Graver Water Conditioning Co. in the Atlanta, Ga. territory. . . . R. M. Brown has rejoined the Bristol Company of Canada as sales engineer stationed in Baltimore. . . . Jack Hause has been appointed manager of the Transportation Division of GE's St. Louis office. . . . Dearborn Chemical Company announces the appointment of Lester R. Sagar as Process Manager. . . .

Fairbanks-Morse announces the appointment of Leonard J. Maguire as Works Manager of their scale plant in Vermont. . . . Diesel Power Company, GM diesel distributors of Oklahoma City and Tulsa announces the appointment of Fred Winn, Jr. as sales representative operating out of the Tulsa office. . . . New manager of Penn Electric Swtich Company Atlanta office is Frank D. Klein.

George H. McBride is the new manager of Westinghouse Electric Company's Gearing Division. . . . New assistant manager of the sales engineering division of Caterpillar is H. J. Hunkele, Jr. . . . Centric Clutch Co., new sales representative in the Toledo, Ohio, metropolitan area is Jesse W. Eakins, 3105 W. Grand Blvd., Detroit 2. . . . New Chief Engineer of the Valve Tappet Division of the Chicago Screw Company is Carl Voorhies. . . . J. Nall Candler is the new administrative assistant to F. M. Hawley, president of Morse Chain Co.

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Young Radiator Co. ... ***

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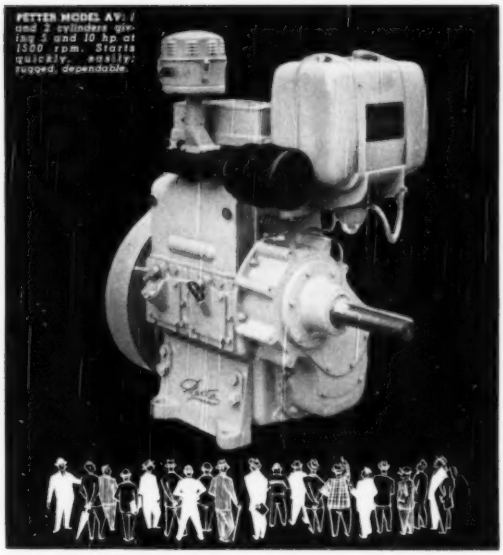
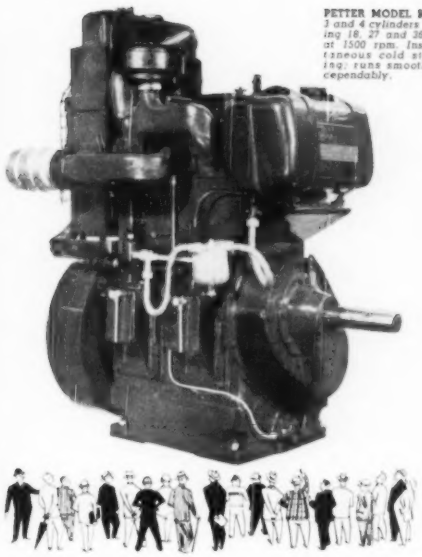


PETTER MODEL AV: 1 and 2 cylinders giving 5 and 10 hp at 1500 rpm. Starts quickly, easily; rugged, dependable.



PETTER MODEL B: 2, 3 and 4 cylinders giving 18, 27 and 36 hp at 1500 rpm. Instantaneous cold starting; runs smoothly, dependably.

World's **biggest value** *in small diesels*

...that's why

Petter is Preferred!

(Engines from 5 hp to 36 hp)

Initial low cost, operating economy, and dependable performance are advantages you receive when you purchase a Petter Diesel. Now available at pound devaluated prices, Petter Diesels are *30% to 40% lower in cost.* Petter Diesels run at *¼ the cost* of gasoline engines – assurance of utmost operating economy.

Ruggedly built, direct injection, 4 cycle operation, Petter Diesels are renowned the world over for the minimum of maintenance they require and the long service they give. *Drive can be taken off either side at engine speed, or off timing gear side at half speed.*

Production of up to 1500 Petter Diesels weekly is the reason ABOE, Inc. can maintain a continuous supply and minimum prices through its nation-wide network of competent and responsible Petter distributors. *Complete information and prices on Petter Diesels gladly sent upon request.*

Petter Diesels are ideal for Compressor Drives, Pumping Units, Road Rollers, Tractors, Stone Crushers, Concrete Mixers, Saw Benches, Refrigeration Machinery and virtually every application where a dependable source of economical power is needed. Petter Diesels available in sizes from 5 hp to 36 hp. Other ABOE, Inc. diesels up to 3,000 hp.

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Petter

ABOE, Inc.
Petter Engine Division
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*Please send me without obligation complete information and prices on the Petter Diesel. Horse power required*_____

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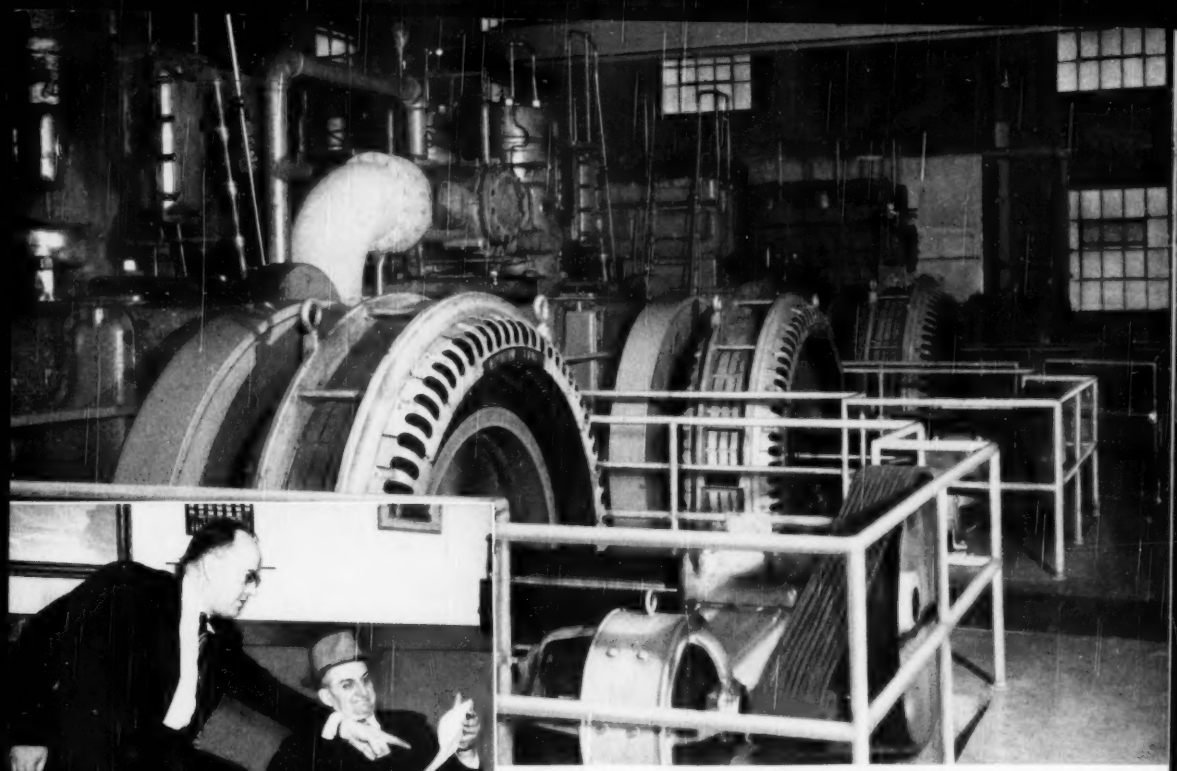

Above—In 1946, STANDARD HD Diesel Oil was tested in a 1400-hp Diesel engine in the Trenton (Mo.) Utilities plant. Today, the success of that trial is reflected by the use of STANDARD HD in the plant's five Diesel engines (one not shown).

Left—W. E. Ralls, plant superintendent, (at the right) and T. N. Okerstrom, Standard Oil Lubrication Engineer, discuss the highly satisfactory report on a recent analysis of STANDARD HD Diesel Oil samples from the plant's engines.

One good job leads to another . . . and another . . . and another!

The experience of W. E. Ralls, Superintendent of the Trenton Municipal Utilities plant at Trenton, Missouri, proves once again that reduction of downtime and maintenance is the Diesel operator's way to judge lubricating oil.

After talking with a Standard Oil lubrication specialist about the advantages of STANDARD HD Diesel Oil, Mr. Ralls put the heavy-duty lubricant to a test in the plant's 1400-hp Diesel engine. STANDARD HD came off with flying colors! The clean and trouble-free operation of this unit sold the new lubricant right into the plant's three 650-hp Diesels. When a new 1600-hp engine was installed in 1948 that, too, was filled with STANDARD HD Diesel Oil.

Today, the success of STANDARD HD on one job after another in this plant is reflected in more reliable Diesel operation and lower maintenance costs.

Let a Standard Oil lubrication specialist help you find how STANDARD HD Diesel Oil can reduce maintenance and overhauls. You can reach him quickly and easily by phoning the nearest local Standard Oil (Indiana) office. Or, if you wish, write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

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